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CHEMICAL AND BIOLOGICAL WARFARE

SECOND EDITION

Al Mauroni





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A Reference Handbook
Second Edition

Al Mauroni

**CONTEMPORARY
WORLD ISSUES**

A B C  C L I O

Santa Barbara, California
Denver, Colorado
Oxford, England

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*To my parents,
Al and Jan Mauroni*



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Preface

When ABC-CLIO approached me to update this reference book, I leaped at the chance. Much has happened in the past five years, in particular as our nation continues to prepare for the possibility of a terrorist attack with chemical or biological weapons. In some ways, this is an old challenge of how to balance resources between taking the attack overseas and preparing for the possibility of incidents and disasters at home. The fear and misunderstanding of what chemical and biological weapons can and cannot do drive this concern to new heights.

Some of this concern is unwarranted. Many people, including highly placed officials who should know better, are quick to raise the concern that "it is not a question of if, but when" terrorists will use "weapons of mass destruction." This term has done more to confuse the issue than focus attention on the challenge. In fact, it may be more probable that terrorists will use industrial chemicals or small amounts of homegrown biological organisms to cause a few deaths and panic thousands than that these same terrorists will come armed with nerve agents and nuclear devices. While responsible public officials must prepare for all circumstances, in reality, the funding and emergency response personnel can only be stretched so far. Then it becomes a public policy issue as to whether we are doing enough or whether the right programs are in place, and if the most probable and dangerous threats are really being addressed adequately.

Truly understanding chemical and biological warfare requires deciphering this complex, technically challenging, emotional, and politically sensitive topic. The common view of chemical and biological weapons is that they are a "poor man's atomic bomb," a term first attributed to the speaker of the Iranian parliament, Hashemi Rafsanjani, in 1988 (Lyell 1996), that they are vile instruments of terror that civilized nations just do not use. This naive and narrow viewpoint ignores the fact that nations owning nuclear weapons have also developed chemical and biological

weapons, not content merely with the nuclear weapon's more destructive capability. This view casually disregards the reality that more countries are investing in chemical and biological weapons programs than in the past, despite the alleged perception that the world finds these weapons "immoral." Countries invest in chemical and biological warfare for very rational reasons: these weapons can be delivered effectively, they can be used to combat insufficiently trained or equipped modern forces or insurgents, and they shorten conflicts that might be very long and expensive. One country that once felt that these weapons were a rational investment was the United States.

Between 1918 and 1990, the United States made significant investments in maintaining an effective chemical weapons capability. This was primarily because the U.S. government wanted to be able to warn its enemies that they would be attacked with chemical weapons if they employed such means against U.S. forces. The U.S. military did not want to be strictly on the defensive, allowing the adversary to choose the time and place of chemical weapons attacks. Between 1942 and 1969, the U.S. government similarly invested in a biological weapons capability, again to counter threats from adversaries that were thought to have an offensive biological warfare capability.

Although the United States has abandoned the strategy of employing these weapons, they are still a modern day threat. President George W. Bush clearly stated this view: "The United States of America will not permit the world's most dangerous regimes to threaten us with the world's most destructive weapons" (White House 2002). Deputy Secretary of Defense Paul Wolfowitz echoed this sentiment: "[Asymmetric threats] include forms of warfare that most civilized nations long ago renounced: chemical and biological weapons and the intentional killing of civilians through terrorism" (Wolfowitz 2001). In a *Meet the Press* discussion, National Security Advisor Condoleezza Rice noted that the Bush administration wanted to "send a very strong signal to anyone who might try to use weapons of mass destruction against the United States. . . . The only way to deter such a use is to be clear it would be met with a devastating response" (Savage 2002).

The question is, are chemical and biological weapons really that dangerous? Many people unintentionally (or perhaps intentionally) place these weapons on a par with nuclear weapons in their discussions of "weapons of mass destruction" (WMDs), also known as nuclear, biological, and chemical (NBC) weapons

or chemical, biological, and radiological (CBR) weapons. Hollywood producers have not helped allay this image, offering such fictional portrayals as *The Rock*, in which guided rockets filled with nerve agent threatened thousands in San Francisco; nor have famous authors such as Stephen King, whose book *The Stand* features a military-bred biological organism wiping out most of humanity. Although chemical and biological agents have the potential for large-scale attacks producing massive casualties, this outcome is often possible only if massive amounts—tons of chemicals or hundreds of pounds of biologicals per kilometer—are laid down over an exposed populace, if no protective measures are taken, and if no medical treatment occurs.

This blind fear of disastrous effects extends to biological agents as well. Not all biological agents are deadly. Outside of plague, smallpox, and Marburg virus (a relative of Ebola virus), most weaponized biological agents are not lethal at all, merely incapacitating. Brucellosis, Q-fever, and cholera will make many sick for days or (if untreated) weeks, but the actual death rate is relatively low. Some strains of tularemia, if untreated, can kill up to 30 percent of those infected. Even in the recent anthrax mail scare, of the twenty-two people infected, only five people died. But the concern that there might be additional biological attacks has unleashed literally billions of government dollars in response activities. Much of this response has been generated by fear of worst-case scenarios rather than by rational decisions based on more probable outcomes.

The U.S. military has been attacked only once with chemical weapons, and that was more than eighty years ago. Through diplomacy, threats of retaliation, and defensive measures, the United States has avoided suffering massive casualties as a result of chemical or biological warfare, either on the battlefield or in its cities. Yet the Department of Defense's 1997 Quadrennial Defense Review concluded that the threat or use of chemical or biological weapons is a "likely condition of future warfare." For that reason alone, it is worthwhile to try to understand more about this threat. This book provides some of the tools that students can use to research the area of chemical and biological warfare, and given that opportunity, to make their own judgments on the facts and opinions provided by many different agencies.

There is a historical basis for the formation of the current perception of chemical and biological warfare. Understanding that history can deconstruct this warfare's doomsday mystique.

This book is not intended to teach readers about the physical properties of chemical and biological agents, nor will it lecture the reader on the morality of this form of warfare. It is intended to educate readers on the reasons that nations and terrorists seek CB weapons and what nations do to protect their military and civilians from this threat. Other nations in the world continue to seek chemical and biological weapons—evidence that they find these weapons capable, manageable, and necessary instruments of war. I hope readers enjoy this addition to this handbook, and that they become familiar with the difficult and complex issues surrounding CB warfare, both in the military and in the emergency response areas.

I would like to thank Mim Vasan and Dayle Dermatis of ABC-CLIO for the opportunity to write this second edition book. Many thanks to Reid Kirby (and in the first edition, Eric Croddy and Howard Beardsley) for his review of the manuscript. Kathy Delfosse greatly improved this book with her thorough copy-editing in the first edition, and thanks to Patterson Lamb for her editing skills in the second edition. Special thanks to my wife Roseann, for her unwavering support through this process.

—Al Mauroni

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1

Background and History

Many authors, in their reviews of the history of chemical and biological (CB) warfare, start in ancient times with the use of diseased animals to spread infection in besieged castles or to spoil wells in the face of advancing hostile troops. These attempts to use CB warfare agents prior to World War I were clumsy and singular events that really do not represent serious military capabilities. This book will limit its historical review, starting with the true birth of chemical warfare, with its wide-scale use on the battlefields of Europe in 1915, and progressing to the present date. Modern biological warfare was first initiated in the provinces of China in the late 1930s, where Japanese military forces attempted to bottle various natural biological pathogens in bombs to subdue Chinese provinces. This era—from 1915 to the present—is where all the relevant discussions and controversies have taken place.

As alluded to in the preface, there are many different approaches to studying CB warfare. There is the strict military measure of the effectiveness of both these special weapons and the defensive tactics required to circumvent them on the battlefield. Actually, CB warfare has been threatened in conflicts many more times than it has actually been used. The threat of possible employment of CB weapons by terrorists has recently enjoyed more attention, but such use can be tracked back to terrorist interest during the 1970s and 1980s. Another approach is through the political arena of arms control and disarmament, which focuses on convincing nations to eliminate the development and use of such unconventional weapons as CB weapons, nuclear arms, landmines, and so on. There is also the scientific review of CB warfare

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agents, which examines what their physical properties are; how they work against people, animals, plants; and how future CB warfare threats might be designed. Given advanced laboratory equipment and the ease of obtaining an advanced education, nearly any nation (or affluent terrorist group) that puts its scientific minds to the task could produce these weapons. Of course, successfully employing CB weapons for the purpose of causing mass casualties is another matter altogether.

CB warfare is a broad field, and this book will attempt to touch on aspects of all of it. A great deal of additional research can be performed to better understand CB warfare; it is merely a matter of deciding what avenue to pursue and what references to use. In approaching this topic, I would make one suggestion: avoid discussions of the morality of CB warfare and of the possibility of government conspiracies. Discussions that try to evaluate the particular morality of one method of killing people versus another are hard to articulate in other than emotional or legal terms. Usually one sees the morality of war as a function of trying to protect noncombatants, such as civilians, medical professionals, and prisoners of war, from unnecessary suffering. It is not clear (to me, at least) that using a chemical or biological weapon against a military force is somehow worse than ordering an artillery barrage on the same unit. Similarly, the idea that some nebulous government agency is secretly ordering CB weapons tests on U.S. military or civilian personnel or has covered up adversarial use of CB weapons against U.S. military forces in the past is fraught with advocacy science, unsupported hypotheses, and often out-and-out, transparent exaggeration. Yet many like to think the worst of government rather than examine the more credible possibilities, and the fear of potential mass casualties added to the perception of government conspiracies and bureaucratic ineptness always seems to sell books and movie tickets.

Defining CB Warfare

The Chemical Weapons Convention (CWC) defines a chemical warfare agent as "any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facili-

ties, in munitions or elsewhere." This very broad definition includes the offensive use of riot control agents (commonly called tear gases) and herbicides, as they have the potential for injuring personnel through their chemical actions. The U.S. military defines chemical warfare agents as "chemical substances that are intended for use during military operations to kill, seriously injure, or incapacitate a person through its physiological effects." This definition deliberately excludes incendiary munitions, riot control agents and herbicides, which may be considered chemical munitions but are not considered to be toxic chemical warfare munitions. The U.S. Senate, as part of its advice and consent to the ratification of the CWC treaty, directed that the United States not be restricted as to the potential military use of riot control agents. Some people question this distinction, believing that the use of chemical munitions such as white phosphorus and napalm (or similar fuel-filled weapons) should be considered chemical warfare, because they are chemicals and, if deliberately used against people, seem to fit the definition. During World War II, the Army Chemical Warfare Service developed and produced incendiary munitions including white phosphorus munitions. These incendiary agents were referred to as chemical munitions as opposed to the toxic chemical warfare munitions (also produced by the Chemical Warfare Service) filled with phosgene and mustard agent. In fact, there have been attempts to define and regulate the use of incendiary munitions. The Geneva Protocol on Prohibitions or Restrictions on the Use of Incendiary Weapons, signed in October 1980, was written to clarify this issue (the United States is not a signatory). It states that civilian non-combatants are not to be attacked under any circumstance with incendiary weapons. It also defines incendiary weapons to distinguish those munitions specifically developed to set fire to objects (such as flame throwers, shells, rockets, grenades, and bombs that contain incendiary substances) from those that merely have secondary incendiary characteristics (such as illumination flares, tracers, and smoke munitions). But in all cases, these are understood to be conventional munitions, unlike chemical warfare munitions.

The ideal chemical warfare (CW) agent is highly toxic in small doses; can be manufactured on a large scale with inexpensive, domestically available raw materials; can be weaponized (that is, delivered via an artillery projectile, aerial bomb, rocket, or a mine) and disseminated over a large area without much loss

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of payload; can be safely handled and transported; and is stable for storage. Chemical warfare is defined as "all aspects of military operations involving the employment of lethal and incapacitating munitions/agents and the warning and protective measures associated with such offensive operations" (DOD 2001, 85). In World War I, the major European powers used industrial chemicals as the first CW agents. Although there were thousands of toxic industrial chemicals in use by commercial industries around the world at that time, a very short list soon emerged as the most effective and lethal agents that could be employed on the battlefield. Between the world wars, Germany developed the first nerve agents, which, since World War II, have become the standard for most nations with an offensive CW program today. Some nations are believed to be continuing research efforts to create more toxic and more persistent CW agents not specifically identified in the Chemical Weapons Convention.

The Biological and Toxins Weapons Convention (BWC) defines biological weapons as "microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes." The U.S. military defines biological warfare (BW) agents as "those biological pathogens and toxins that are intended for use during military operations to cause death and disease among personnel, animals, or plants, or to deteriorate material." BW agents include bacteria, viruses, rickettsia, and fungi as pathogens, and poisonous toxins derived from biological organisms (such as snake venom, ricin from castor beans, toxins from moldy bread, and the like). Like CW agents, potential BW agents are numerous; there are thousands, if not tens of thousands, of microbial organisms in the natural environment, of which hundreds have the potential for causing some degree of harm to people, livestock, or crops. Some are contagious; many others are not. BW agents that are ideal for military operations are easily disseminated in aerosol form in small amounts over large areas to expose large numbers of people, animals, or crops; have high potency, causing casualties in short order; store well for long periods; and have medical countermeasures that a nation can give to its own troops and civilians.

Most BW agents are grown in laboratories using initial stocks drawn from natural sources and selected for use against specific targets (humans, specific breeds of animals, or specific crops). There are very few BW agents that are lethal to both humans and

animals or to both animals and crops. Russia does not agree to including toxins among biological warfare agents, largely because toxins are chemical in nature and can be synthesized in a laboratory. Toxins cannot reproduce and cannot “infect” people who have not ingested the toxin. With a few exceptions, most toxins are relegated to use in assassinations rather than in attacks covering large areas. By weight, toxins are much more lethal than CW agents, but toxins cannot penetrate skin as some CW agents can and they do not act as quickly as CW agents do.

Following the events of September 11, 2001, there has been an increased emphasis on preparing for the possibility of non-state actors (terrorists, cult groups, militias, lone gunmen, and the like) using chemical or biological hazardous substances in addition to obtaining CB weapons from nation-states. Terrorists today could employ the same toxic industrial chemicals used in World War I as improvised weapons, using chemicals such as chlorine, chloropicrin, hydrogen cyanide, and phosgene instead of manufacturing military-grade CW agents. Similarly, non-state actors have attempted, with various degrees of success, to culture different biological organisms for use against unprepared citizens. Terrorist groups and individuals cannot match the production levels or dissemination capability of nations. As a result, they do not necessarily seek to cause mass casualty events but can cause a few deaths and considerable panic with CB hazards.

These definitions, developed by arms control negotiators for politicians attempting to draw up internationally accepted rules for warfare, allow for a common understanding of what constitutes CB weapons, but they do not really give one a good understanding of why these weapons were created or how successful (or unsuccessful) they have been. A review of the history of CB warfare is the best forum for discussing what kinds of CB warfare agents exist, for identifying what defenses can be developed to protect against these agents, and for understanding why nations develop offensive and defensive CB warfare programs.

In the Beginning—World War I

Prior to the outbreak of World War I, attempts were made to at least limit the unchecked destructiveness of war, primarily through international arms control conventions. One early convention was the Hague Declaration Concerning Asphyxiating

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Gases, signed on July 29, 1899. This short declaration noted that "the Contracting Powers agree to abstain from the use of projectiles the object of which is the diffusion of asphyxiating or deleterious gases." The U.S. government was not a signatory to the 1899 Hague Declaration. Captain A. T. Mahan, a famous naval strategist, was a United States delegate to these talks and recommended against the United States signing the declaration:

- "1. That no shell emitting such gases is as yet in practical use, or has undergone adequate experiment; consequently, a vote taken now would be taken in ignorance of the facts as to whether the results would be of a decisive character, or whether injury in excess of that necessary to attain the end of warfare, the immediate disabling of the enemy, would be inflicted.
2. That the reproach of cruelty and perfidy, addressed against these supposed shells, was equally uttered formerly against firearms and torpedoes, both of which are now employed without scruple. Until we knew the effects of such asphyxiating shells, there was no saying whether they would be more or less merciful than missiles now permitted.
3. That it was illogical, and not demonstrably humane, to be tender about asphyxiating men with gas, when all were prepared to admit that it was allowable to blow the bottom out of an ironclad at midnight, throwing four or five hundred into the sea, to be choked by water, with scarcely the remotest chance of escape. If, and when, a shell emitting asphyxiating gases alone has been successfully produced, then, and not before, men will be able to vote intelligently on the subject." (Avalon 2003)

On October 18, 1907, the European nations signed the Hague Convention Respecting the Laws and Customs of War on Land, noting that it was especially forbidden "to employ poison or poisoned weapons" (Reisman and Antoniou 1994, 47, 57). Other clauses in the convention addressed the definition of belligerents, the use of naval contact mines, the use of expanding bullets, and the treatment of prisoners. The common theme was one of protecting both combatants and noncombatants from unnecessary suffering and devastation during times of armed conflict.

The Great War erupted, and soon nations saw massive waves of their men and equipment thrown against each other on the European continent. Far different from earlier conflicts, this war quickly evolved into a deadlock in the trenches, with troops gaining a few miles on one day only to see their gains reversed in the next month. With forces evenly matched, both sides were seeking an advantage to move the conflict forward.

German scientists proposed using toxic chemicals to break the deadlock. They felt that although this approach technically violated the Hague Conventions, it was justified by French use of riot control agents (ethyl bromoacetate) against German forces in August 1914 (although the effects were practically unnoticeable). The German military leadership was skeptical but it was willing to try a new approach. The first large-scale gas attack was against the British forces on October 27, 1914, using 105 mm artillery shells filled with dianisidine chlorosulfate, a lung irritant. The British did not notice any effects because as the shells exploded, the chemical component was destroyed. Early German experiments on the Russian front in January 1915 and against the British in March 1915 using artillery shells filled with xylyl bromide did not demonstrate any success. This could have been because of the cold weather and the low volume of agent released by the (relatively) small artillery projectiles (Smart 1997, 14). These observations required a change of operations.

Dr. Fritz Haber, a German scientist and consultant to the German War Office, thought that chlorine gas would be more effective in driving soldiers from their trenches, primarily because it was volatile enough to be driven by the wind and yet would not leave any prolonged aftereffects that might deter attacking forces. Chlorine was available to Germany in large quantities because of the country's commercial dye industry, and using gas cylinders to project the chlorine would ensure that the new form of warfare would not compete with the demands for high-explosive artillery shells. In January 1915, the German high command approved the concept and decided to implement it at Ypres (Hanglian 1940, 2–3).

German engineer troops brought thousands of gas cylinders filled with chlorine to the Ypres battlefield, and by March 10 they had positioned the cylinders in their trenches. Because the wind direction was predominantly west to east, they had to wait for optimal wind conditions prior to releasing the chlorine gas. On April 22, 1915, at five o'clock in the morning, they released 168

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tons of chlorine, creating a yellow fog over five miles in width. Although the attack successfully drove the French and British from the trenches, the Germans were soon stopped by Canadian reinforcements (Hanglian 1940, 167–169). Because this attack had been viewed as an experiment, the German military command had not planned to reinforce it, and they lost the tactical initiative. The Germans used chlorine again at Ypres on April 24 and four more times in May, gaining ground against the unprepared Allied forces.

Although the Allies initially railed against the German use of chemicals, they decided that not having their own gas warfare capability would be far worse than using it, from both morale and tactical perspectives. The British released their first chlorine cloud in September 1915, on the Loos battlefield, using thousands of cylinders and releasing more than 150 tons of chlorine. It was a spectacular failure, but the attack did not stop the British from throwing their resources into the venture (Haber 2002, 55). Both sides invested in development of new gases and new delivery systems to harass and demoralize their opponents. These gases took the form of two major classes: nonpersistent gases, and vesicants, or blister agents. The former can be subdivided, according to their effects on personnel, into asphyxiators, or choking gases (affecting the lungs); toxic blood agents (inhibiting the body's ability to transport oxygen through the blood system); sternutators, or sneeze gases (causing vomiting that would force a person to take off his mask); and lacrimators, or tear gases (irritants).

The choking agents included chlorine, phosgene, diphosgene, and chloropicrin. More than 80 percent of gas fatalities were caused by phosgene, which is more than ten times more toxic than chlorine. The blood agents included hydrogen cyanide, cyanogen chloride, and cyanogen bromide. The sneeze gases were generally arsenic-laced chemicals; not very deadly at first, they had a delayed toxic effect. Tear gases included ethyl bromoacetate, bromoacetone, and bromobenzyl cyanide. Early masks protected only the respiratory system, which forced a redesign to protect the eyes from these tear gases. Because these chemicals are lighter than air and disperse quickly, they had to be delivered in massive amounts (through mass artillery barrages, cylinders, or projectors) if they were to have much effect on unprepared troops.

Because these chemicals had odors—and in many cases, colors—alert troops could be warned of the gases' presence and could don gas masks prior to becoming incapacitated by their ef-

fects. Once it became apparent that the use of these chemicals would not carry the battles by themselves, both sides used them to harass the enemy. In an effort to improve these weapons, both the Germans and the English investigated vesicants such as mustard agent (often incorrectly referred to as "mustard gas" but actually a liquid), and lewisite, which was developed very late in the war. These liquids inflamed and damaged body tissues, causing temporary blindness, raising huge blisters on unprotected skin, and damaging the respiratory tract if inhaled. Mustard agent is not lethal, and the British initially deliberately ignored it because of this trait, not recognizing its very effective incapacitating capability. Mustard agent was first used by the Germans against the British at Ypres on July 12, 1917, killing 87 and incapacitating 2,000 after a barrage of 50,000 shells. While phosgene caused the most deaths, mustard agent caused the most injuries of all the war gases. More than eleven months later, British and French forces were using their own mustard projectiles against the Germans. Up to 50 percent of artillery projectiles were chemical filled by the end of the war.

Both sides developed defensive equipment in response to the gases, including protective masks for humans, dogs, and horses; impregnated clothing for protection against the vesicants; warning horns and gongs; and improvised collective protection shelters in the trenches. When the United States sent the American Expeditionary Force to France in 1917, the British and French military had to provide U.S. soldiers with protective gear and chemical munitions. The U.S. military had not prepared for gas warfare, despite knowledge about the threat for years. In September 1917, the U.S. Army formed the Gas Service, which had the responsibility to train and equip its forces and to develop an offensive capability designed on the British mortars and French 75 mm artillery. After initial heavy losses resulting from poor gas discipline, the Americans learned to protect themselves. They recognized the need to develop an inherent military capability to specialize in this area.

The War Department created the Chemical Warfare Service in June 1918 to organize an effort that was being executed by the Bureau of Mines (research and development), the Ordnance Department (production of agents and filling chemical shells), the Medical Department (procurement and supply of gas masks), the Signal Corps (procuring gas alarms), and the Corps of Engineers (offensive training and actual employment of gas). On July 1,

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1918, Major General William Sibert, an architect of the Panama Canal and former 1st Infantry Division commander, became the first director of the Army's Chemical Warfare Service. The Army built four CW agent production plants on Edgewood Arsenal in Maryland in 1917–1918 to produce chlorine, chloropicrin, phosgene, and mustard agent. The arsenal produced more than 930 tons of phosgene and 710 tons of mustard agent by the end of the war; although the CW agents were shipped to France, no shells were manufactured with them in time to support American forces. The American Expeditionary Force's 2d Chemical Battalion would use British Stokes mortars and Livens projectors and French artillery batteries during their operations in Europe.

Many U.S. military commanders were reluctant to employ a weapon with which they had no experience. Some thought that their use of gas weapons would cause the Germans to retaliate with gas against them, and so abstained. When the Germans attacked with gas regardless, the Americans began to use gas in support of their attacks. General John J. Pershing, commanding general of the U.S. forces, referred specifically to aircraft, tanks, and poison gas as the three weapons making major impacts during the Great War. In a statement still quoted today, he declared, "Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question" (Pershing 1920, 77).

At the end of the war, nearly one-third of all U.S. soldiers evacuated to military hospitals had been casualties of gas warfare—about 70,000 in all. Of these casualties, slightly more than 1,200 died, or about one in every sixty gas cases. By comparison, artillery in general had caused nearly 75,000 U.S. casualties, of which about one in ten died in the wards. Gas was not a major battlefield killer, but it had a significant emotional impact on how the military and the public perceived the conflict.

Congress authorized the permanent formation of the Chemical Warfare Service in 1920, with the rationale that this form of warfare would continue to be a threat. In the bill authorizing the service, the Congress stated that the duties of the Chemical Warfare Service

comprise[d] the investigation, development, manufacture or procurement and supply of all smoke and incendiary materials, all toxic gases, and all gas defense appliances; the research, design, and experimentation

connected with chemical warfare and its material; and chemical projectile filling plants and proving grounds; the supervision and training of the Army in chemical warfare, both offensive and defensive, including the necessary schools of instruction; and the organization, equipment, training, and operation of special gas troops.

Because of the visibility of surviving veterans' wounds, gas warfare became a rallying point for postwar arms control efforts. Following the war, a number of treaties addressed chemical and biological warfare. The most important one was the Geneva Protocol of 1925, which called for nations to abstain from the use of chemical or biological weapons in future conflicts. Many nations interpreted this protocol to mean any and all gases, including riot control agents. Nearly all interpreted it as authorizing a nation to use chemical or biological agents in response to a belligerent's first use of such weapons in a conflict. As such, the protocol did not ban the development and storage of these weapons, merely their first use. At the time, the Senate did not ratify the treaty, stating it was unrealistic to expect a nation to limit itself in its potential defenses against adversaries armed with chemical weapons. This was not an endorsement of gas warfare; rather, the Senate was acknowledging that despite the existence of treaties, gas would be used in future conflicts and the U.S. military had to be prepared.

The Threat Increases—World War II

Prior to the outbreak of war in Europe, there had been indications that the coming conflict would include the use of chemical weapons. An Italian general, Giulio Douhet, came forth with a popular theory on future military operations. He saw the development of bombers and chemical warfare coming together to create a new threat against military forces and the civilian populace. He went so far as to suggest that nations should reduce their procurement of ground and sea forces to focus on air power, for once an opponent's air bases were destroyed, the cities would be next. Gas bombs would demoralize the populace until they forced their government to surrender (Van Creveld 2000, 162–168).

In 1935, Italian forces in Ethiopia successfully employed aerial-delivered mustard bombs and mustard-filled spray tanks

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against tribesmen in the mountains to quickly conclude the conflict in months instead of the several years that had been projected. Italy justified this use by stating that Ethiopians had tortured or killed their prisoners and wounded soldiers and that the Geneva Protocol had an exception that allowed gas warfare as reprisal against illegal acts of war. Japan had experimented with chemical and biological warfare in its invasion of China, using mustard-filled shells and tear gas grenades mixed with smoke screens against Chinese forces and targeting several large cities with biological agents delivered from the air. Although the BW attacks were not militarily significant, they increased the panic and numbers of war casualties in China, resulting in a formal protest by the Chinese government to the League of Nations in 1937. The response from the League of Nations against Italy and Japan was relatively mild and served only to increase concerns that future wars would feature the use of poison weapons.

France and England had developed their own chemical warfare stocks, but Germany was forbidden by the Versailles treaty from developing chemical weapons in its country. Observing the letter of the treaty but not the intent, German scientists traveled to the Soviet Union in the 1920s to cooperatively develop chemical capabilities (both industrial and military). The discovery of nerve agents was an accident, for the Germans were actually developing an indigenous insecticide production capability that was not dependent on oil imports. Once the war started, the Germans did build a limited chemical weapons stockpile but had assumed that the Allies had already discovered nerve agents; after all, the Allies had not been restricted in their technical research as the Germans had been (Harris and Paxman 1982, 53–54).

The U.S. government entered World War II with very few chemical weapons in its inventory and with practically no capability for delivering them on the battlefield. The U.S. military leadership was very nervous about fighting a two-front war against countries that already had demonstrated a chemical warfare capability. Japan had not ratified the Geneva Protocol, and Germany's ally Italy had already demonstrated the capability of chemical weapons in Ethiopia. President Franklin D. Roosevelt ordered the development of a retaliatory capability, which resulted in a very large investment in building chemical ammunition plants, testing grounds, and laboratories to invent new defensive equipment such as chemical agent detectors, protective masks and suits, and decontaminants. This resulted in the formation of Pine Bluff Arse-

nal, Rocky Mountain Arsenal, Dugway Proving Ground, Camp Sibert, and Camp Beale, among other installations. The United States soon developed huge stocks of mustard gas, lewisite, phosgene, cyanogen chloride, and hydrogen cyanide. The U.S. military built up overseas stockpiles of CW agents, producing more than 146,000 tons by the end of 1945, allowing the United States to retaliate quickly if it came under attack by German or Japanese CW munitions. The military had also developed new weapon systems to deliver the agents, to include a new 4.2 inch chemical mortar, aerial bombs, and spray generators.

The United States initiated its biological warfare program in 1942, in close cooperation with the Canadian and British governments. During the 1930s, there had been a great deal of research on the practical employment of BW agents in Europe but not in the United States. Camp Detrick, in western Maryland, sprang into existence in April 1943. It included a number of laboratories and a pilot plant that manufactured weapons-grade botulinum toxin and anthrax spores. Although a larger plant was constructed in Terre Haute, Indiana, and tested with biological simulants—substances that have some of the features of a chemical or biological warfare agent that are used by evaluators to assess the agent's effectiveness without actually using toxic substances—it was not ready prior to the invasion of Europe and never manufactured any anthrax. (For a complete view of the Chemical Warfare Service's work during World War II, reference the Center of Military History's three-volume collection; Brophy and Fisher 1959; Brophy and Miles 1966; Kleber and Birdsell, 1966.)

Americans storming the beaches in Africa, Italy, and Europe all had gas masks, impregnated suits, and information cards detailing the signs and symptoms of gas poisoning. Decontamination troops landed right behind the infantry in the major invasions, ready to clean the beaches in case they had been hit by CW agents. More than 400 chemical battalions and companies, numbering more than 60,000 military personnel at the peak of enlistment, were supporting combat troops with specialized chemical offensive and defensive expertise. These specialized Army units included chemical mortar battalions that used their high-explosive munitions to support combat troops (as no chemical weapons were employed), smoke generator battalions and companies, depot companies that stored and maintained the chemical defense equipment, processing companies that prepared impregnated chemical protective clothing, decontamination companies,

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chemical staff in the theater, army group and army headquarters elements, and laboratory companies for technical intelligence assessments. There were also chemical service units supporting the Army Air Force, specifically in the storage and handling of incendiary bombs. No one was willing to neglect the requirement to defend against the potential use of CB weapons.

Despite the presence of chemical weapon stockpiles in Europe and in Asia, no major power used any of these weapons. There has been much speculation as to why nations did not use these weapons to gain a military advantage over their adversaries. All the ground forces had significant defensive capabilities, and all the major powers had the industrial capability to produce CW agents in large enough quantities to allow their armed forces to launch and sustain decisive offensive operations. There was considerable discussion over the use of gas warfare for military operations, including Prime Minister Winston Churchill's calling for plans to defeat a German invasion of the United Kingdom by using mustard agent against the invaders. Although some debated the morality of using these particular weapons, many others had little trouble discussing the employment of CB weapons as methods to stop large-scale invasions of their country or to reduce the massive casualties suffered in the Pacific theater, or as retaliatory threats to counter enemy use of the same. The United States, having signed but not ratified the Geneva Protocol, could have unilaterally employed gas against the Axis within the letter (but not the spirit) of international law. In the end, attacking forces relied on the speed and shock of conventional warfare, where the use of gas could have slowed down these operations in favor of the defender.

Major General Alden Waitt, the chief chemical officer in 1945 and assistant chief chemical officer during World War II, appropriately noted that the earlier lack of use of toxic gases did not justify the conclusion that they would not be used in the future. The Germans had produced more than a quarter of a million tons of toxic gas, including thousands of tons of tabun nerve agent. Their failure to use this gas was largely attributed to the fear of retaliation. The United States should not, Waitt felt, assume that other nations would refrain from using gas when it could serve their purposes (Smart 1997, 45). Congress agreed, and on August 2, 1946, it codified the Army's Chemical Warfare Service as the Chemical Corps (an act that President Roosevelt, an ardent opponent of chemical warfare, had refused to approve).

The Cold War Starts

Following World War II, the United States and the Soviet Union both discovered the German nerve agent production facilities, and both began intense research and development efforts to better understand these new weapons. These nerve agents included tabun, sarin, and soman and are often referred to as the "second generation" of chemical weapons (the first generation being the industrial chemicals and mustard agent employed in World War I). These agents were much more lethal than their predecessors, but several years of research were required to understand their effects and limitations as weapons and how best to design defensive equipment to detect them, to protect against them, and to decontaminate personnel and equipment if the weapons were used against them.

Although the newly named Chemical Corps had been reduced in size after the war, like much of the U.S. military, the Korean conflict ignited concern that U.S. forces might face CB weapons developed by Soviet and Chinese facilities. The Army built a nerve agent production plant at Muscle Shoals, Alabama, in 1950, which would be producing sarin nerve agent by 1953. Stocks of chemical warfare agents and munitions were moved to an Army depot on Okinawa as a retaliatory capability prepared to respond to any adversarial first use of chemical weapons. Although the U.S. military did not use CB weapons during the conflict, the Chemical Corps supported forces in Korea with smoke and obscurant operations and by delivering incendiary munitions. The Chemical Corps activated a new training center, moving their school from Edgewood Arsenal in Maryland to Fort McClellan, Alabama, in 1952.

Following the Korean conflict, the Chemical Corps lost its 4.2 inch mortars to the infantry branch, but it retained its research and development role in respect to CB weapons. With the production of new nerve agents in production and corresponding new defense equipment, the Chemical Corps was exceedingly busy in the 1950s. Chief Chemical Officer Major General Egbert Bullene stated in 1953, "Today, thanks to Joe Stalin, we are back in business" (Smart 1997, 48). Primarily as a result of British research, the United States developed a more persistent nerve agent, called VX, by 1955. This thick, oily liquid could be aerosolized and disseminated on the battlefield to create a long-term hazard (lasting days to weeks) to unprotected personnel.

The Soviet research community developed their own variant of VX as well. The V-class nerve agents became called the "third generation" CW agents.

The United States had not developed biological weapons past their limited experience at Camp (later Fort) Detrick, so it initiated a new research and development effort that would lead to the production of biological weapons and to the stockpiling of weapons for a retaliatory capability (Covert 1994). The North Korean government claimed that U.S. pilots had bombed their forces with biological weapons, but these accusations were not credible at the time—the United States had no practical offensive BW capability in 1952—and these claims were proven false decades later. By the late 1960s, however, the United States did have a formidable BW stockpile. It had weaponized anthrax, botulinum toxin, and tularemia as lethal anti-personnel agents. Brucellosis, Q-fever, staphylococcal enterotoxin type B (SEB), and Venezuelan equine encephalitis (VEE) virus represented its incapacitating anti-personnel agents. There three anti-crop agents—rice blast, rye stem rust, and wheat stem rust—were developed and stockpiled for aerial spraying (Christopher 1997, 414). Investigations into the potential weaponization of anti-animal and other anti-personnel BW agents continued at Fort Detrick, if for no other reason than to ensure that the U.S. military could determine whether an adversary were using these agents and to develop medical countermeasures against them.

The two superpowers had CW stockpiles stationed in Europe and Asia in preparation for what many thought would be a third world war. If U.S. forces had no chemical weapons and were attacked by Soviet chemical weapons, it was reasoned, the United States would have to retaliate with tactical nuclear weapons, which might start an escalation to strategic nuclear exchanges. Far better to keep the conflict below the nuclear threshold. In response to this line of logic, the U.S. Army, Air Force, and Navy developed chemical weapons, including aerial bombs and spray tanks, unguided rockets, artillery shells, land mines, and guided missile warheads for their respective airplanes, artillery systems, and ships, ensuring that they all had the capability to retaliate in kind to anticipated Soviet chemical weapon use.

These new weapon systems and new agents also drove the need for better understanding of how they worked on the open battlefield. In 1961, Defense Secretary Robert McNamara initiated a number of defense projects, one of which, titled Project

112, focused on open-air trials of CB warfare agents and simulants. The Army opened Deseret Test Center in Utah, next to Dugway Proving Ground, to support the execution of these tests, which also were conducted on the open seas, in the tropics, and in an arctic environment.

The Vietnam Conflict

The conflict in Vietnam brought a new type of battle to the U.S. forces, one in which conventional styles of warfare were pitted against an untraditional adversary. Although the U.S. government decided against the use of unconventional munitions to fight the Vietcong and North Vietnamese, the Chemical Corps did develop colored smoke grenades, improve its riot control agents, and develop herbicides that supported combat operations. The United States initially began Operation Ranch Hand, the name of the defoliant operation in Vietnam, at the request of the South Vietnamese government, to destroy the rice farms that were sustaining the Vietcong forces. U.S. forces soon discovered the value of spraying herbicides around their bases, limiting the ability of enemy forces to sneak up to them. Similarly, eliminating the foliage at riverbanks and where the enemy operated reduced the chance of ambushes and lowered the casualty rates for the U.S. military.

There had been no previous testing of the potential long-term effects of herbicides on exposed persons, either for civilian use in the United States or, certainly, for the large quantities used for military operations in Vietnam. The same chemicals had been used in much smaller quantities on American lawns, and few had noted any severe effects described by veterans years after the conflict. There was no independent federal oversight in this area, as the spraying took place prior to the establishment of the Environmental Protection Agency (EPA). These herbicides were suspected of causing a number of illnesses in exposed soldiers and civilians in the area, but many symptoms did not show up until years later. After initially denying benefits to U.S. veterans, the U.S. government acknowledged that exposure to herbicides was related to wartime-related injuries and that the service members should be compensated for exposure to these herbicides.

The increased presence of U.S. forces, starting around 1965, correlated with increased use of riot control agents and brought

strong rebukes by other nations and arms control proponents. Reporters noted that U.S. military advisors had begun to carry tear gas grenades and protective masks for self-defense. U.S. troops used riot control agents to flush out enemy forces in tunnels and to create a harassing and nauseating effect on animals and personnel traveling on enemy supply routes. Many critics attacked this employment of tear gas as a violation of the 1925 Geneva Protocol. The U.S. government strongly disagreed that employing tear gas was a treaty violation but held that even if it were a violation, the government was still not bound to an international treaty it had never ratified. The Chemical Corps was heavily invested in the research for chemical incapacitants (other than riot control agents), which would become another source of controversy for the military. Agent BZ, the only incapacitating agent standardized by the Army, did not show any military operational value as it took two to three hours to affect troops and was visible as a cloud during its dissemination.

While this debate raged, the Soviet-trained and equipped Egyptian Air Force was dropping chemical-filled bombs on Yemeni royalists embroiled in civil war. Despite clear evidence of chemical warfare, very little was done to reprimand Egypt or to investigate the Soviet Union's role in arming and training the Egyptian Air Force. U.S. military strategists dismissed the use of chemical weapons as an aberration and not relevant to future conflicts with the Warsaw Pact. To this day, Egypt has continued to deny its involvement in chemical warfare during the Yemeni civil war.

Changing Perceptions — 1968–1976

Increasing environmental awareness, the publicized use of riot control agents and herbicides in Vietnam, and the Nixon administration's arms control agenda drove an increased effort to prohibit CB warfare and to disarm the major superpowers. Part of this effort was a result of the expanded discussions on "weapons of mass destruction" or WMD. In 1948, the United Nations Commission for Conventional Armaments had adopted a definition that defined WMDs as "atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which have characteristics comparable in destructive effort to those of the atomic bomb or

other weapons mentioned above" (SIPRI 1971, 193). While the Department of Defense had not considered chemical or biological weapons as "WMDs" in the 1950s and 1960s outside of strategic arms control discussions, these arms control issues had grown in number and been publicized by numerous media sources to the point that people were indeed considering CB weapons to be as dangerous as nuclear weapons. What pundits had lost sight of was that to equal the devastation of a nuclear blast, literally tens of tons of lethal chemical or biological warfare agents were required (and not all CB warfare agents are lethal).

Public perception of the danger of CB weapons would, however, considerably impact the U.S. government's CB weapons programs. Between 1968 and 1972, a series of events occurred in the United States that drove the CB weapons program out of business. In March 1968, the Army was accused of causing the deaths of more than 6,000 sheep on ranches near Dugway Proving Ground, Utah. Attention focused on an open-air test of VX nerve agent in which the chemical was dispersed from spray tanks mounted on a F-4 jet at a test range thirty miles from the ranches. Despite the lack of any concrete or forensics evidence that pointed to the proving ground's testing, Army leadership decided to settle the ranchers' monetary losses without admitting liability (Mauroni 2000, 29–43).

The political and media uproar resulting from this event continued for more than a year and led to increased scrutiny of the U.S. government's CB warfare programs. In early May 1969, several congressmen and mayors protested the Army's plans to dispose of aging munitions by sinking retired Liberty ships full of chemical munitions more than 200 miles off the East Coast. Although there had been (and continues to be) no evidence of any ill effects resulting from the sea burial operations, the Army stopped this disposal practice and, in line with independent scientific recommendations, made plans to incinerate its obsolete and leaking munitions.

The United Nations commissioned a special report on CB warfare, releasing it in July 1969. This report stressed the danger of nations' engaging in CB weapons development, not merely to noncombatants but also to the nations' own military forces. That same month, a reported nerve agent leak at an Army depot in Okinawa increased the media focus on the Army's chemical weapons policy. Again, although the exposed personnel reported no long-term ill effects, the mere fact that the U.S. government

had chemical weapons overseas ready for employment was disturbing to many. Neither the Japanese government nor the American public had known that the weapons were there. These weapons were moved to Johnston Island (located 800 miles southwest of Hawaii) in 1971.

President Richard Nixon called for a review of the government's CB warfare program in light of arms control proposals and military plans and policies. This review led to his announcement on November 25, 1969, that the U.S. government would renounce its offensive biological warfare program, would reaffirm the "no first use" policy for chemical warfare, and would stop producing CW agents until the new binary CW agents (binary agents consist of two parts that do not come together until they are used) were available. In 1972, the U.S. government signed the BWC, which would enter into force in 1975. By 1973, the United States had destroyed all of its stockpiled BW agents and toxins. Although it was not Nixon's intent to stop the Army's effort to modernize its chemical weapons, the resulting discussions in Congress over the policy changes and the future of the U.S. government's role in CB warfare had the effect of stalling the Army's binary chemical weapons program until the 1980s.

These events also indirectly led to the Army's proposed disestablishment of the Chemical Corps in January 1973. General Creighton Abrams, chief of staff of the Army, was remodeling the Army after the Vietnam conflict and proposed consolidating the special weapons function of the Chemical Corps into the Ordnance Corps. In January 1973, he announced that the Chemical Corps was disestablished. Congress had to make the final decision, as the formation of the Chemical Corps had been approved by that body in 1946. Congress did not approve the disestablishment, perhaps out of concern about the need for future CB defense capabilities, and instead returned the issue to the secretary of the Army in 1976 for his decision.

The Arab-Israeli War reignited the Army's desire to develop and retain defensive CB capabilities. The Israeli army had captured Egyptian forces that had Soviet-designed chemical defense equipment, including portable collective protection shelters, chemical agent detectors, decontamination kits, and medical countermeasures. This seemed to indicate that the Soviet Union was still very interested in CB warfare. If the Soviets were supplying their allies with this equipment, what were they preparing to do in Europe against U.S. forces? Ken Alibek, a noted former

Soviet bioweapons researcher, revealed in his book *Biohazard* that the Soviets had suspected that Nixon's declaration was merely an attempt to drive the U.S. BW program under covert cover, so they had redoubled their efforts. One indication of the Soviets' offensive BW program was the accidental anthrax release at Sverdlovsk in April 1979. Hundreds were killed in this incident, which President Boris Yeltsin admitted in 1992 had been the result of a malfunction at a Soviet military BW production plant (Alibek 1999, 234; Spiers 1994, 37).

The Army decided to stop the disestablishment of the Chemical Corps in 1976 and to reopen the Chemical School at Fort McClellan in 1979, in part out of its concern that it could not afford to neglect a strong CB defense capability. Unfortunately, the Army's disestablishment efforts had left the Chemical Corps at least a decade behind the rest of the world in the development and acquisition of CB defense equipment, a delay that could have been very costly when the Army had to respond to Iraqi forces invading Kuwait in 1990. Military forces were better trained and equipped in the late 1980s than in the 1970s, but they nevertheless would have to deploy without a number of new CB defense items that were just coming out of research and development. As the Army reestablished its Chemical Corps, it also began to reexamine modernizing its offensive CW weapons.

Disarming the Superpowers

The United Kingdom and France had publicly declared their CB weapons stockpiles and took steps to eliminate them in the 1950s, but until the two major superpowers agreed to a new arms control program, the threat of chemical warfare would continue. International negotiations had started in the late 1960s, when the U.S. government initiated new talks focusing on chemical weapons disarmament with the Soviet Union in 1977. Following years of failed attempts to craft a new arms control agreement with the Soviets and after reports of Soviet chemical warfare in Afghanistan, the U.S. military moved to modernize its chemical weapons capability. This decision was very controversial, for it was seen by many as contrary to the spirit of international arms control. The U.S. government's position was that developing a modern retaliatory capability and pursuing an arms control agreement were not mutually exclusive options. After years of

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debate, Congress approved President Ronald Reagan's requests to produce binary chemical munitions in 1985, and the first 155 mm binary artillery projectiles began coming off the production line at Pine Bluff Arsenal, Arkansas, that year. This production effort brought the Soviet Union to the table for serious negotiations, which resulted in the decision to halt the U.S. binary chemical munitions program in July 1990. The U.S. Army moved its chemical weapons from Germany in September 1990, storing them at Johnston Island until they could be destroyed.

In January 1993, 130 countries signed the Chemical Weapons Convention treaty in Paris. This treaty prohibited its signatories from developing, producing, storing, or transferring chemical weapons, and it included a ban on using or assisting others to develop chemical weapons. It also called for the destruction of existing chemical weapons and production facilities, and for its signatories to refrain from the use of riot control agents as a form of warfare. This treaty had a vigorous declaration procedure and inspection regime, which would be overseen by the Organization for the Prohibition of Chemical Weapons (OPCW), stationed in The Hague, Netherlands. The treaty entered into force after the sixty-fifth country ratified the language, on April 29, 1997. (The United States ratified the CWC on April 25, 1997.) To date, 178 countries have signed and 165 countries have ratified the treaty.

The United States initiated the destruction of its older chemical weapons in 1985, initially to make room for the new binary chemical weapons, but later (after 1990) to meet their treaty obligations under the CWC. The disposal program deadline was set at 2007 to align with the CWC's deadline of disposing of all stocks within ten years. There is still a great deal of controversy about using incineration as a process to destroy these munitions, but no one has been injured as a result of storage or disposal operations. Because of this controversy on what technology and processes the United States should use to dispose of its 31,400 tons of chemical weapons, the elimination of the U.S. chemical stockpile will not be completed prior to 2007. Russia's planned disposal of 40,000 tons of chemical weapons is not on schedule for similar political and environmental concerns, but also, more important, for economic reasons (lacking the necessary funds to destroy these weapons). Although the U.S. government has assisted the Russian government in developing a program to dispose of these weapons, there is little chance that destruction of the stockpile will be completed on schedule. The CWC treaty al-

lows for a five-year extension to its deadline, which the United States has already requested.

Continued Proliferation

As the superpowers destroy their CB weapons, a number of smaller countries have shown an interest in building them. We will investigate this more in chapter 3, but just as an example, consider the Iran-Iraq War of 1983–1988. Both sides developed and employed chemical weapons, and there was little censure from the major powers other than the initiation of export control regulations in an attempt to slow down the flow of chemical precursors and equipment to these countries. Certainly, the United States faced its greatest credible threat from CB weapons since the Cold War during the 1990–1991 Persian Gulf War. Although Iraq did not employ its CB weapons against the U.S. military (during the Persian Gulf War or the second Gulf War in 2003), Iraq demonstrated the emerging threat that any country with ballistic missiles and a CB weapons program could present to its neighbors, threatening both military forces and the civilian populace. Additional countries in the Middle East continue to have sophisticated weapons programs, as well as North Korea and other Asian nations.

Despite the label of immorality that CB weapons have inherited, many countries continue to pursue their creation, a task made somewhat easier by the development and global marketing of dual-use technologies (equipment and material used for both military and civil purposes), by the sharing of intellectual property around the world, and by greater access of higher education among the residents of more countries. Although arms control advocates like to call CB weapons “a poor man’s atomic bomb,” this label is inappropriate. China, India, Pakistan, and Israel are four countries that have nuclear weapons, yet all are suspected of developing or having the potential to develop CB weapons. Iran, Iraq, Libya, and North Korea have also sought nuclear, biological, and chemical (NBC) weapons capabilities. Primarily, it is thought that these countries seek unconventional weapons as a deterrent against their aggressive neighbors’ stockpiles or as a threat to their weaker neighbors. In addition, marketing CB weapons technology could be a great potential moneymaker on the Third World market.

Although the OPCW has the protocols and personnel to conduct inspections of nations suspected of reneging on their treaty obligations, all of its visits to CWC signatory nations have been routine inspections as opposed to challenges. In the past, the superpowers have been loath to accuse these proliferators because that might reveal intelligence sources and cause the offending nations to simply move their production and storage sites to unknown locations. President George W. Bush, in an attempt to force the issue past international treaty obligations and protocols, instituted a Proliferation Security Initiative (PSI) in May 2003 with several nations. The objective of the PSI is to forcibly board and confiscate any materials and munitions relating to NBC weapon production, if those materials were bound to a "rogue nation" or known weapons proliferator. While this practice has mixed reviews as to its legality and efficacy, it remains an option for reducing the ability of other nations to develop, store, transport, and use CB weapons.

Homeland Security Concerns

The concept of "homeland security" is not a new one. Since 1941 the U.S. government has created, modified, disestablished, and recreated organizations focused on protecting the United States from enemy attacks using unconventional weapons. Between 1941 and 1995, the focus was on the scenario of a nation-state using military units or covert operatives to deliver unconventional weapons against U.S. cities. While the Soviet Union was considered the major threat between 1950 and 1989, a military strategy evolved to counter the strategic bombers and ballistic missiles that were aimed at the United States, involving counterforce (attacking the weapon sites and related military and civilian targets), active defense (destroying the incoming bombers and missiles), and civil defense (ensuring the survival of citizens and the continuation of government). The need to counter non-state actors (terrorists, criminals, religious cults, and lone individuals) who might use CB warfare agents against the public was a serious possibility, although not seen as the most likely threat.

Since the 1970s terrorists across the world have considered and threatened the use of CB weapons, but prior to October 2001 there had been only one successful case of BW terrorism in the United States. Similarly, the notion of CW terrorism was seen as

a hollow threat before the Tokyo subway incident in March 1995. The Aum Shinrikyo cult manufactured its own sarin and even some BW agents in their preparations for what they thought was an upcoming worldwide apocalypse. In March 1995, members of the cult, which is credited with a number of CW incidents in Japan, released a sarin mixture at a dozen locations in the Tokyo subway. The number of casualties from this event is often mistakenly stated as being more than 5,000 civilians. This number refers to the large number of panicked citizens (the "worried well") who flooded the hospitals, thinking that they had been exposed to nerve agents because they were on the subway trains about the time of the attacks. Twelve Japanese citizens died, and more than 900 people developed noticeable symptoms of nerve agent poisoning, including 135 emergency responders (Sidell et al. 1995).

The recent appearance in this country of four anthrax-laced letters, killing five people and affecting hundreds, has reinforced the desire to develop capabilities to protect U.S. citizens from CB terrorist attacks. The outbreak of thousands of anthrax hoaxes across the nation resulted in millions of dollars in wasted resources, as emergency responders scrambled to assess what they later discovered to be sugar, flour, or crushed white candies. Such hoaxes are not only a U.S. concern; countries all over the world have experienced (and continue to experience) similar anthrax hoaxes and have had to respond to panicked emergency calls about "suspicious white powders." The question becomes, what is the proper government role and responsibility to prevent and respond to terrorist CBRN incidents?

In October 2001, the White House created an Office for Homeland Security, and Defense Secretary Donald Rumsfeld appointed Army Secretary Thomas White as the temporary head to execute Department of Defense homeland security efforts. In January 2002, the Bush administration released its *National Strategy for Homeland Security*, which included as major initiatives detecting chemical and biological materials and attacks and improving chemical sensors and decontamination techniques. In February 2003, the Department of Homeland Security (DHS) was formally established, as was the DoD office of the assistant to the secretary of defense for homeland defense. Their focus has been nearly exclusively on the threat of terrorist attacks against the United States, and a majority of their interest is on countering the threat of terrorist use of chemical, biological, radiological, or nuclear

(CBRN) hazards. The term "CBRN" was deliberately created in 1999 to differentiate this threat from that of weapons of mass destruction, because of the envisioned much smaller impact of hazards employed in most terrorist scenarios. Many antiterrorism experts will include the threat of high-yield explosives (E) in that focus, leading to the term "CBRNE," given other unconventional terrorist incidents such as the Oklahoma City bombing in 1995 and the attack against the World Trade Center towers in 2001. In fact, it is much more probable that terrorists would use explosives, knives, and guns in their activities than CBRN hazards. We shall, however, focus on the CB hazards and not the entire range of terrorist capabilities.

The Department of Defense has the preponderance of technical and operational experts in CBRN defense, including several special military units that practice and are prepared to deploy to support the federal response to CBRN terrorism. Because the role and resources of the Department of Defense are limited, the Office of the Secretary of Defense has carefully defined aspects of what makes up homeland security; these include all government efforts to prevent terrorist attacks within the United States, reduce the vulnerability of the United States to terrorism, and minimize the damage and assist in the recovery from terrorist attacks. The Department of Defense supports two specific aspects of homeland security: homeland defense, which includes protection of U.S. territory, domestic population, and critical defense infrastructure against external threats and aggression; and civil support, which includes support to civil authorities for domestic emergencies and for designated law enforcement and other activities, such as the deployment of CB technical experts and operational units to assist federal, state, and local response to terrorist incidents. There is a third aspect of homeland security called emergency preparedness that includes all governmental actions required to plan for and respond to natural or man-made disasters as designated by the president. In the case of CBRN terrorism, this can include participation by the EPA (for decontamination support), the Department of Health and Human Services (DHHS, addressing CB medical countermeasures), and the Centers for Disease Control and Prevention (CDC, addressing biological disease identification and information), for instance.

The number of studies, meetings, and discussions about the possibility of terrorist CB incidents within the United States has exploded since the fall of 2001. In fact, of the fifteen planning sce-

narios that DHS considered in 2004 for the purposes of developing its planning activities, eleven of the fifteen were terrorist CBRN incidents (four chemical, five biological, one radiological, and one nuclear), with the other scenarios being two natural disasters, one explosives situation, and one cyber attack. Although there has yet to be a mass casualty incident in the United States resulting from the use of terrorist CB hazards, many pundits have warned for years that "it's only a question of when, not if." The worst-case scenario has been coordinated and simultaneous terrorist attacks against multiple cities using a contagious biological disease such as smallpox or plague. Because of the potential mass casualties that might occur based on this worst-case scenario, the government believes that it must spend billions of dollars to prepare for such an event.

Conclusions

This is a very quick highlight of the history of chemical and biological warfare. The twentieth century saw a rapid evolution of CB warfare from its humble beginnings in industrial enterprises to an influential weapon of war and an instrument of terror. Over this period of time, it received more than its fair share of myths and exaggerations, political hype, and public hysteria. The idea that the use of chemical and biological weapons on the battlefield could be a completely rational and not an immoral act amounts to heresy among many unfamiliar with this history. Isaac Asimov once stated, "If a scientific heresy is ignored or denounced by the general public, there is a chance it may be right. If a scientific heresy is emotionally supported by the general public, it is almost certainly wrong," and in the same article, "It is not so much that I have confidence in the scientists being right, but that I have so much in nonscientists being wrong. . . . It is those who support ideas for emotional reasons only who can't change" (Asimov 1978).

What Asimov may have been pointing out is that a lack of education on specific subjects causes people to make judgments that may be emotionally rather than intellectually based and as a result, to misunderstand the issue. Certainly this corollary applies to CB warfare. It takes a broader frame of reference to understand why militaries and terrorists seek out CB weapons. The mistake many people make is to focus on how CB weapons work

and how they kill rather than looking at this issue in the broader context of armed conflict and politics. Whereas people focus on the lethality of a single drop of CW agent or a gram of BW agent, they rarely focus on how a single bayonet or a single round of full metal-jacketed ammunition can also kill an individual. Think about the ammunition in a sporting goods store and do the math; if each bullet can kill one individual, how many deaths are possible from one store's inventory? Of course, no one views handgun and rifle ammunition as "weapons of mass destruction," but similarly, it is just as fanciful to think about CB warfare agents as mass casualty weapons based merely on their lethality. One has to frame their use on the battlefield, which takes into consideration the weather, the weapon systems, and their intended target's training and preparedness.

To understand the real potential and shortfalls of CB weapons requires a broader perspective. The researcher should not merely read books about CB weapons (such as this one) but also investigate how military units operated on past battlefields and how they operate on current ones, how nations negotiate arms control treaties (not just on CB warfare but on other topics as well), and how terrorists operate to advance their agendas. It is with this broader education that one can really understand the role that CB weapons have played in our history and understand that these weapons, despite their larger-than-life image as "weapons of mass destruction," are at once less doomsday weapons and in a large measure just another tool of war. There are many issues that will remain unclear to the reader after concluding with this book: How did the military discover and design these specific weapons? Why have arms control treaties failed to stop the proliferation of CB weapons? Are there instances when nations would be justified in using CB weapons, such as Churchill's urging that preparations be made to use mustard agent against potential German invaders in World War II? Is the threat of terrorist use of CB warfare agents a real and current danger to the United States or just an exaggeration?

This book is merely a first step. Understanding the nature of CB warfare is necessary to learn the nomenclature, the issues, and the events where the use of CB weapons has been considered. After this education, the researcher must continue and examine the broader tapestry of how nations, militaries, and politicians exercise war and diplomacy. Then one can truly understand how the arms control treaties in this area have succeeded or

failed, why nations continue to invest resources in building offensive CB warfare capabilities, and exactly how much the general public should worry about the future of CB warfare.

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2

Problems, Controversies, and Solutions

There is no end to the issues and controversies related to chemical and biological warfare. This is partly because of a natural distaste some people have when discussing a form of warfare that essentially affects humans like insects—to be exterminated by invisible, odorless gases and poisons—and partly because of misunderstanding or misinformation of how military forces employ these weapons. Even within the military, the offensive use of CB weapons has always been controversial, for it is not seen as an “honorable” form of combat such as face-to-face battles. Some controversies are born from the lack of understanding or deliberate exaggeration about what CB weapons can and cannot do in the open environment. And when misinformation is combined with a dash of advocacy science and the fear that the government is not looking out for the public’s best interests, the stories about CB warfare grow.

Countries and non-state actors continue to develop these weapons, and since their existence represents a current threat, it is important that the public as well as the military understand what they can and cannot do. Military forces use poison gases because they disable and kill people, and military forces train to use them as they do other weapon systems in order to achieve predictable and measurable effects. There are two sides to each of the following discussions: the dry, historical review of government actions, and often a judgmental view of the appropriateness of these actions. It is incumbent upon the reader to further research each side to better understand how these issues developed and where the

controversy lies. Do not take any presented issue on its face value (not even the ones offered below); do the research to understand that the issues are not as simple as they may appear.

The U.S. Offensive CB Weapons Program

Current and former administration officials and military officers such as General Norman Schwarzkopf have expressed their dismay that potential adversaries of the United States have CB weapons programs that could be employed against U.S. military forces or U.S. citizens (Schwarzkopf 1992, 356, 389–390, 416, 419, 439, 451–452). In particular, these officials often view CB warfare as a form of combat that only rogue states and terrorists would employ, especially given the CWC and other arms control treaties. It may be somewhat surprising to some, then, to discover that the United States itself had a significant stockpile of these same weapons and as recently as the late 1980s was attempting to replace aging stocks with modern binary chemical munitions. What was the rationale behind arming U.S. forces with these supposedly immoral weapons that only “cowardly” nations would use?

President Franklin Roosevelt developed the first policy on offensive use of chemical weapons in 1942, warning the Axis powers that the United States would retaliate with chemical weapons if attacked by enemies using them (Spiers 1986, 73). Because the United States had only a very small stockpile of chemical weapons and no production capability to back up that warning, it embarked on a rapid buildup of research facilities, proving grounds, and weapons production to ensure that the armed forces could carry out this mission. Many analysts believe that this retaliatory capability was a major factor in preventing Germany from using its CW agents against the Allies.

President Harry Truman continued the “no first use” policy when discussions took place on the role of CB weapons in the Korean conflict. Determined to keep the conflict “limited,” he directed the military not to use chemical weapons unless attacked in kind. The high casualties resulting from the Korean conflict caused some to consider a change in CB warfare policy. In 1956, the senior military leadership proposed establishing a new national security policy that would allow commanders to use CB weapons if there was a military advantage to be gained, rather than waiting for the other side to attack first with its CB weapons

and then retaliating. This policy was discarded by President Nixon, who reaffirmed the "no first use, retaliate in kind" national policy for the employment of chemical weapons.

Through the 1960s and 1970s, this policy—of retaining chemical weapons to deter other nations from using them against the United States and to retaliate if deterrence failed—remained the primary rationale for maintaining an active offensive chemical weapons program. The concern was what the U.S. response would be if the Soviet Union or its allies used CB weapons against U.S. forces. If U.S. military forces could not respond in kind, the United States could only retaliate with tactical nuclear weapons, and this response could escalate to strategic exchanges. This rationale drove the Army, Air Force, and Navy to produce and test new CB weapons for their aircraft and artillery systems, thus developing a tactical response to adversarial CB weapons use.

The countering argument, against maintaining an active offensive chemical weapons program, has been that as long as the United States maintains a chemical weapons stockpile, other nations will want to develop their own CB weapons capability to ensure a level field of combat, thereby increasing the proliferation of CB weapons across the globe. If the United States has chemical weapons, then why shouldn't other countries? Also, a government gains a certain cachet, if only to impress its own people, by having an unconventional weapons capability equivalent to that of a superpower. Some critics believe that the United States should not produce even small amounts of CB warfare agents to test defensive equipment (which is currently permitted under international treaty), as this action could encourage potential adversaries to continue research into more exotic agents that could bypass current detectors and protective ensembles.

There has always been concern that the U.S. military cannot develop and test CB weapons without inadvertently harming civilians or military personnel involved in the tests. Some suspect that open air tests of simulants over metropolitan cities in the 1950s and 1960s contributed to the poor health or even death of some unprotected persons (Cole 1988). Controversy over the testing conducted at Dugway Proving Ground has continued since the incident in 1968 when a CW agent was alleged to have killed a large number of sheep. Even if the nerve agent did not kill the sheep that time, there have been concerns that the local community might have been exposed to low levels of CW agents (more on this discussion below). How would one know? The agents are

colorless and odorless, and the government did not tell the community when the tests took place or what agents were used. Such fears have led to speculation that unexplained illnesses within a community near or involved in a CB weapons study, even if the study involved only simulants, may have been caused by the Army's testing.

Herbicides, Incendiaries, and Tear Gas

Unlike the European nations, the United States does not view herbicides, incendiary munitions, and riot control agents as chemical warfare agents. Before 1975, the U.S. military defined these as chemical munitions. The difference is that munitions filled with nerve and blister agents were "toxic chemical agent munitions" and the others, such as those filled with herbicides, napalm, and riot control agents, were merely munitions that dispensed a chemical substance instead of high explosives. On the other hand, white phosphorus and riot control agents came from similar military laboratories, filled similar munition shells, were employed by military specialists, and fit the CWC definition as chemicals that could "cause death, temporary incapacitation or permanent harm to humans." This point of debate has had more to do with arms control policy than how such materials were used by military forces.

The main difference to military operators was that, as a practical matter, the U.S. military did not employ herbicides or riot control agents to kill or permanently incapacitate their intended targets. These chemical agents, in particular, have been employed to save military and noncombatant lives. U.S. forces used riot control agents to prevent enemy adversaries—particularly unconventional troops in urban settings—from using noncombatants as shields, to break up unruly crowds, or to control prisoners of war who were attempting to escape. Herbicides were used to clear out potential ambush areas and to deny the enemy the cover that would allow them to creep up on troop emplacements. The use of chemicals in these applications did not equate, to the U.S. government at least, to the military use of toxic chemicals.

This issue rose to the level of public scrutiny during the Vietnam conflict, when reporters noted that U.S. military advisors were carrying tear gas grenades and protective masks for self-defense into the field. As the level of military involvement in-

creased, so did the use of riot control agents. The U.S. military used powered generators to pump riot control agents into the Viet Cong tunnels and dropped riot control agents onto enemy supply routes. These acts were viewed as offensive rather than defensive measures, as it appeared that U.S. forces were using a chemical to force persons from their tunnels only to be captured or shot. As such, critics saw this as violating the Geneva Protocol.

Critics pointed out that the "first use" of tear gases could escalate to military forces using lethal chemical warfare gases instead of merely temporary incapacitants. The Department of Defense noted that it was inconsistent to classify riot control agents as CW agents when used by the military but not when used by many nations' police forces, who routinely used the same riot control agents. One would think that a CW agent was a CW agent regardless of who was using it. While the U.S. government still holds that herbicides and riot control are not CW agents, the military does require presidential approval to employ them during wartime conflicts, even in defensive roles. During the Persian Gulf War, military police were granted permission to employ riot control agents to control enemy prisoners of war.

The use of the herbicide Agent Orange is similar in that the U.S. and South Vietnamese governments were not targeting people with herbicides. The South Vietnamese government requested U.S. support in denying rice crops to the enemy. This effort grew from an anti-crop campaign to a deforestation operation when troops realized they could eliminate cover for enemy soldiers seeking to ambush patrols leaving their fire bases and boats maneuvering on the rivers. Agent Orange and other herbicides and defoliants were used in such great quantities that their impact on crops and forests was felt for decades. And it was suspected that the dioxin created in the mixing of Agent Orange could have affected U.S. military personnel and Vietnamese across the countryside. Was this deliberate chemical warfare or just unintentional collateral damage? The question is not asked to excuse the government for the harmful effects of dioxin; rather, it illustrates that the use of herbicides, in and of itself, is not and was not intended as chemical warfare.

In downtown Moscow in October 2002, Chechen rebels took 900 people hostage in the Dubroka Theater. Because the Chechens had wired the theater with explosives, the Russian military decided to use a narcotic gas similar to the anesthetic fenantyl to subdue the Chechens. The hope was that the gas would incapacitate

the rebels prior to their being aware of any attack. Unfortunately, nearly 130 of the hostages died as a result of heavy exposure to the narcotic gas. Because the event was characterized as a terrorist incident, the Russian government largely avoided public criticism from other nations (including the United States). The question remains as to whether military forces and police forces should develop and employ incapacitating (and potentially lethal) gases for domestic law enforcement without this appearing to be endorsing the use of a toxic chemical warfare agent.

Human Volunteer Testing

Certainly one of the most controversial topics is the use of human volunteers for testing CB warfare agents. During World War II, the United States and Britain called for soldier volunteers to be exposed to mustard gas and lewisite under two conditions: while unprotected, and while using protective masks and clothing. The intent of these trials was to better understand the effects of vesicants on exposed persons and to develop better protective measures against potential enemy use. For a long while, it was common practice for chemical warfare specialists to receive a pinpoint of mustard agent on their arm so they could observe firsthand the effects of the agent and so they would be able to identify blister agent use on the battlefield. (This practice was discontinued when it was discovered that exposure to mustard agent increased the person's sensitivity to later exposures.) At least in the United States and Britain, human volunteers were never exposed to lethal CB warfare agents or high concentrations that would imperil their lives.

The discovery of tests conducted by the Japanese and Germans on human subjects drove the development of the Nuremberg Code in 1947, instituting strict guidelines on the role of human experimentation (Nuremberg War Crimes Trials 1949). In 1953, the U.S. military redesigned its guidelines on human volunteer testing based on this code, which specifically addressed the testing of chemical, biological, and radiological agents. Officially, all CB warfare projects were to be approved by the secretary of the Army, but this provision was not always followed according to the letter of the law. For instance, between 1959 and 1975, the Army had a blanket approval for testing nonlethal incapacitating agents on human volunteers (Pechura and Rall 1993, 378-380).

One of the best-known cases of this was Operation Whitecoat, which involved Army soldiers who were Seventh Day Adventists, conscientious objectors who joined the Army as non-combatants. These men were deliberately exposed to controlled releases of Q-fever and tularemia at Fort Detrick (to help in developing vaccines) and Dugway Proving Ground (in simulation of the effects of a battlefield release). Although this may seem controversial, the volunteers were fully informed of the nature of the tests and were told that none of the agents were lethal. All agreed to the tests, and all of them fully recovered following the tests (ABC News 2001). Following congressional hearings on the subject in 1975, the military canceled all CB weapons testing on human volunteers. Congress called for (and continues to require) annual reports of any Department of Defense experiments or studies involving human subjects for testing CB warfare agents. There have been no human volunteer tests using CB warfare agents since 1975.

Open Air Testing

Closely related to this issue is the open-air testing of CB agents and simulants by the Army and Navy in the late 1950s and through the 1960s. The military wanted to find out to what the extent weaponized agents covered large areas. Because they could not use actual BW agents in populated areas, they used zinc cadmium sulfide, which fluoresces under ultraviolet light, to simulate biological particles. This chemical was sprayed by aircraft over the countryside so that its coverage could be determined. The Army also used *Bacillus subtilis*, also called *Bacillus globigii* (BG), to simulate the release of anthrax and *Serratia marcescens* to simulate tularemia releases. The Army felt that the low levels of these agents that eventually landed on earth would have represented little to no hazard to the environment or to people. The controversial element was that no studies had been conducted to determine the potential hazard to the general public. Some individuals, such as those with respiratory problems, the old, or the very young, may have been at risk from exposure to these simulants. More controversy arose because the public was not alerted to these tests; had they been told about them, they could have taken precautions. Of course, from a security perspective, that alert could have tipped off the Soviet Union to the nature of the tests.

The toxic chemical weapons tests conducted by the military in the 1960s and early 1970s have recently attracted more attention. Open-air exercises using small amounts of toxic chemical agents were conducted for training purposes at Aberdeen Proving Ground (Maryland), Fort McClellan (Alabama), and Dugway Proving Ground (Utah) for years without incident prior to 1972. These exercises involved small quantities of CW agent that probably dispersed very quickly without imperiling unprotected civilians within or outside the base. The military held larger exercises using toxic chemical agents at Fort Greeley (Alaska), Deseret Test Center (Utah), and Oahu (Hawaii), in addition to spraying exercises in the Pacific, in an effort to test and refine delivery systems that would disperse CW agents.

One of the more publicized series of exercises is Project Shipboard Hazard and Defense (SHAD) held in the 1960s, in which the military was trying to determine the vulnerability of U.S. warships to attacks with CB warfare agents and the potential risk to American forces posed by these agents. Although military personnel were involved in the tests, they were not the subjects of these tests; the purpose was not to learn the effects of CW agents on humans but to determine the protective measures required on ships. More than thirty years later, the former military personnel involved in Project SHAD question whether their current health problems may have resulted from these tests. Although no one suffered any illnesses or reported medical problems at the time of the tests, knowledge is lacking about potential health effects from low levels of chemical exposure combined with years of exposure to other health hazards in the environment. Proving that this possible exposure resulted in adverse health effects at this late date is next to impossible, but it remains a volatile issue as politicians assure veterans that their health costs will be covered.

The Army continues to test their biological detectors by using BG to simulate anthrax releases. In April 2002, the Army released a cloud of clay dust, egg white powder, ethanol, and irradiated BG spores off the Florida Keys to determine whether a military radar system, modified with a software algorithm, could detect a cloud of potential CB warfare agents. The test parameters were developed with participation from state and federal health agencies, including the Environmental Protection Agency, the Federal Aviation Administration, the National Weather Service, the U.S. Fish and Wildlife Service, the Florida Keys National Marine Sanctuary, and others. The Army did alert the public well

in advance of the tests, and a few people worried that somehow they could get sick from the exposure (CNN 2002). Following the Florida tests, no one reported any ill effects.

The 1968 Dugway Proving Ground Incident

On March 15, 1968, local ranchers approached Dugway Proving Ground scientists to solicit their help in identifying a mysterious malady. A few thousand sheep had been afflicted with a strange disease, unable to rise to their feet and drooping their necks. The sheep had not responded to any medications, and an investigation was soon initiated. Attention soon focused on the open-air nerve agent trials conducted at Dugway, more than thirty miles from the ranches, and in particular, on an F-4 jet that had been testing a spray generator dispersing VX agent on the proving ground. When it was discovered that the sheep had ingested an organophosphate of unknown origin, the governor of Utah quickly blamed the U.S. Army and demanded redress.

The Army's seeming complicity was compounded by its policy of not publicly commenting on the conduct of CB weapon systems at its primary proving ground, which should be unsurprising as this incident came at the height of the Cold War. No one wanted to release to the press what would have amounted to national security information. In their defense, the Dugway personnel had previously conducted 170 nerve agent spray trials without incident, plus hundreds of other weapons tests conducted there. Through test cards and a tracer color in the VX agent, they could account for nearly 98 percent of the agent dispersed during that trial. What that meant was that if the sheep had been sickened by the VX, then less than 2 percent, or five gallons, of VX had floated more than thirty miles, over a mountain range, onto the fields where the sheep herds fed. Although scientists and engineers considered this downwind hazard travel to be improbable by meteorological principles and although state and federal investigators had found no physical evidence that the agent had traveled to the sheep range, the governor (who was up for reelection that year) and others were claiming that the agent had made the sheep sick (Mauroni 2000, 34-41).

The Army leadership in Washington was briefed on the incident, and although they were unconvinced that it was VX that had injured the sheep, they decided to pay the ranchers for the loss of their uninsured herds. The intent was to make the problem go away so the politicians would be happy and the Army could resume its tests at Dugway. That was not the message received by the media, which saw this as a tacit admission of guilt and an attempt to dodge responsibility for what was perceived as an out-of-control CB warfare program. The initial 2,500 injured sheep became a claim for 4,400 disabled sheep put down by ranchers, plus another 1,900 that were potentially exposed (and therefore not marketable), which the press rounded out to "more than 6,000 sheep killed by nerve gas" (Thompson 1997, Israelsen 2002).

But there is also a much simpler possible explanation: suspicions remain that local ranchers may have sprayed their crops with an illegal organophosphate pesticide, which drifted a few miles to the sheep's feeding grounds, and that when the sheep ate the sprayed grass, they became sick with symptoms similar to those of nerve agent poisoning. The ranchers panicked and blamed the Army, a position that the politicians were quick to support in an election year. In any case, when it appeared that the Army would give them a blank check, the ranchers started shooting and burying the sheep before the Army, state, and federal investigators completed their examinations into the cause of death.

The furor over the incident caused Congress to cancel the military's open-air CB weapons testing and severely constrained the attempts to initiate the binary chemical weapons program. But without the ability to test and explode weapons on a test range, there is no credible way to tell how these weapons disperse their contents and therefore how to develop effective defenses against them. The Department of Defense's investigation of the 1991 Khamisiyah depot explosion is one example of their failure to understand how modern CB weapons work (more below on the Khamisiyah incident). Nearly every CW incident since 1968, including use of Agent Orange, human volunteer tests associated with the CB warfare program, the chemical demilitarization program, and Gulf War illness, has been tied to the Army's handling of the 1968 incident at Dugway Proving Ground.

President Nixon's 1972 Biological Weapons Program Declaration

In his pronouncement unilaterally ending the U.S. offensive biological weapons program on November 25, 1969, President Nixon declared, "These steps should go a long way towards outlawing weapons whose use has been repugnant to the conscience of mankind. . . . Mankind already carries in its own hands the seeds of its own destruction. By the examples that we set today, we hope to contribute to an atmosphere of peace and understanding between all nations" (*New York Times* 1969). The irony is that the Soviet Union's response to this speech was to redouble its efforts to maintain its offensive BW program, and other nations continued developing their own offensive BW programs rather than stopping their efforts. Did President Nixon really believe this was an immoral weapon "repugnant to the conscience of mankind?" Did he really believe that the world would disarm based on his example, or was this a political move designed to capitalize on his popularity early in his first term? Why exactly did Nixon sign a unilateral disarmament executive order?

There were certainly grounds for the president to order a review of the government's CB warfare program in June 1969. The Dugway Proving Ground incident was still fresh in everyone's mind, as was Operation CHASE (Cut Holes and Sink 'Em), a program to bury conventional and chemical munitions at sea. Information disclosed by the press had revealed that the U.S. military had overseas chemical munition stockpiles in Europe and Okinawa. The United Nations had initiated its own academic review of CB warfare in January, with its final report released in July. The UN report noted that "[w]here these weapons ever to be used on a large scale in war, no one can predict how enduring the effects would be, and how they would affect the structure of society and the environment in which we live" (Teltsch 1969). This dramatic statement, developed by fourteen scientists and without consideration of military utility, made a splash in the international headlines and had to be responded to.

President Nixon had directed a review of the U.S. government's CB warfare policy and issues in May, and on November 25, 1969, he announced the complete abandonment of an entire class of weaponry that had been in development for nearly thirty

years, an unprecedented action. Nixon's own records do not give much information on why he decided to change existing policy. Some have speculated that Nixon dropped the BW program strictly as a political move to divert attention from Vietnam, but in 1969, his standing in the polls was very high, and the mass demonstrations against the conflict were yet to occur. One possible explanation is that he was trying to score a quick win against a Democratic majority Congress in his first term, and he chose to do this through an aggressive arms control agenda, which included topics such as the Anti-Ballistic Missile (ABM) treaty and Nuclear Non-Proliferation Treaty (NPT). Nixon knew that once he proposed the elimination of the biological weapons stockpile, the Democratic leadership could ill-afford to not support this action (Mauroni 2000, 49–51).

The National Security Council had sponsored the review of U.S. policy on CB warfare, examining the Department of Defense's stated policy and actual practices in developing lethal CB agents, incapacitating CB agents, herbicides, riot control agents, and anticrop agents (Kissinger 1969). The study recommended against further investments in the BW program but supported modernizing the CW program. The view was that maintaining an offensive BW agent stockpile was not necessarily the best deterrence option, that the agents were uncontrollable, and that the BW program was not worth the potential military effectiveness that the agents delivered. Also, if the United States stopped its offensive BW program, there would be less incentive for other nations to continue a program, thus allowing the United States to retain its technological lead (White House 1969).

This conclusion was not supported by the program's past performance. At that point, the U.S. Army had been researching biological weapons for more than twenty-five years and chemical weapons for more than fifty years. The military understood these agents' effects on personnel, they had developed efficient and effective delivery systems, and they had carefully tested and measured the effects. A weapon of war is not useful if the commander cannot predict the results of employing it, and the Army had done its testing well. Its main BW agents, anthrax, tularemia, botulinum toxin and SEB toxin, were nonreplicating anti-personnel agents that could be controlled without concern about epidemic outbreaks. Although infectious anti-personnel BW agents were studied, the United States did not plan to weaponize them (unlike the Soviet Union). President Nixon's decision was a cal-

culated political move, not the moral decision many have painted it.

Congress moved to drastically reduce the defense budget's research and development of the offensive CW program, in addition to eliminating the offensive BW program, even though the intent of the Nixon administration was to retain and modernize its chemical weapons stockpile. The series of public gaffes, including the use of Agent Orange in Vietnam, the Dugway sheep incident, and the discovery of U.S. chemical munitions overseas, had damaged the Army's credibility. As a result, Congress stripped much of the funding for the military's offensive CW program after 1969. When Congress increased the Army's funds to develop CB defense equipment and binary chemical weapons in the 1980s, many arms control advocates became alarmed over the action. But as the program was barely funded throughout most of the 1970s, any increase must have seemed large.

The Binary Chemical Weapons Program

The U.S. military's quest for modern chemical weapons started in the late 1950s as a result of the Navy's seeking chemical munitions that could be safely stored on aircraft carriers. The concept of a binary munition—which combined two relatively safe precursor chemicals that react in flight to release a lethal CW agent—was seen as an answer to that issue. The Army also saw this as a good modernization effort to replace its unitary chemical weapons, since binary weapons would be safer to store in peacetime, safer to transport in wartime, and safer to dispose of when they were obsolete. Research continued through the 1960s and into the early 1970s, slowing down in the 1970s because of congressional limitations on the Army's offensive CW program following President Nixon's 1972 reaffirmation of "no first use."

With the resumption of an active Chemical Corps in 1976, the Army decided to push for a modern chemical weapons retaliatory capability, noting that its unitary munitions were aging (the last chemical munition being produced nearly a decade earlier) and that it needed weapon systems that were compatible with new weapon platforms. The Carter administration initially rejected the Army's requests, focusing on arms control talks with the Soviet Union. When it appeared that these talks were not bearing fruit and that the Soviets were increasing their CB warfare capabilities,

the administration agreed to include a budget request for a binary chemical weapons program in its last budget submission to Congress. At the last moment, President Jimmy Carter pulled the program out of the budget, leaving it to the Reagan administration to make the case for binary chemical weapons.

The Reagan administration supported Army requests to fund the production of a binary chemical munitions plant, outlining their initiative as eliminating the global CW threat in a two-part initiative. It would support the development of a verifiable chemical weapons treaty while deterring the use of chemical weapons against the United States by revitalizing the U.S. military's retaliatory CW capability. Congress authorized the construction of a binary weapons plant at Pine Bluff Arsenal without authorizing any actual production of binary weapons. The Army continued research and development of a 155 mm and an 8 inch artillery projectile, a Multiple Launch Rocket System (MLRS) warhead, and the Navy's Bigeye bomb.

The level of debate over the development of binary weapons increased dramatically, with critics accusing the Chemical Corps of supporting a binary weapons program only to secure its recent revival and accusing the Army of not supporting the international arms control talks. Scientists debated the efficacy of the binary munitions, with some arguing that it was hard to justify a new class of nerve agent munitions that were untested and not evaluated against the unitary design. Since the open-air test ban was still in place, the Army was validating these munition designs using simulant-filled projectiles and bombs at its proving grounds. This led to discussions that the binaries might be inferior to the weapons they were replacing, as some postulated that the components might not create a 100 percent lethal mix prior to the weapon's dissemination over its target.

Other critics decried the entire concept of developing modern chemical weapons, noting that the U.S. efforts could encourage other nations to invest in their own chemical weapons program. Thus, this line of reasoning went, the binary program was actually increasing the threat of chemical warfare to U.S. military personnel rather than decreasing the threat by its retaliatory mission. Congress called for the president to form a commission to review the U.S. military's chemical warfare posture and to make a recommendation as to whether the United States should produce binary chemical weapons.

The Chemical Warfare Review Commission released its report in April 1985. The report concluded that only a small fraction (less than 20 percent) of existing chemical weapons had any military value and that the bulk agent stored in ton containers was militarily useless and should be destroyed. The commission thought that, given the growing Soviet threat, the modernization of the stockpile would be more likely to encourage negotiations for a multilateral, verifiable ban on chemical weapons and that it was not realistic to expect defensive measures alone to offset the advantages the Soviets would gain from a chemical attack. This led to their conclusion that the proposed binary program would provide an adequate capability to meet the military's needs and was necessary. This report, endorsed by the administration, led Congress to release funds in 1985 to start production of the 155 mm artillery projectiles at Pine Bluff Arsenal.

The countering view from the arms control proponents was that the best policy to prevent chemical warfare was international chemical disarmament. If, to show its sincerity, the United States had to unilaterally disarm prior to the Soviet Union, this should have been the course of action rather than proliferating the threat. The binary program was seen by the arms control community as an obstacle showing that the United States was less willing to negotiate the fine points of a treaty banning all chemical weapons. Certainly, the 1970s had seen progress in nuclear arms talks, the Biological Weapons Convention, and other similar international treaties. One of the obstacles to the arms control talks was the need for a verification process to ensure that once a nation started disarming, it remained disarmed. With the large number of chemical weapons in existence, the technical points of exactly how inspectors would enter a country, inspect a site, challenge a government's records, and report its findings became the subject of loud and long debates.

Another challenge was determining what future role the unitary chemical munitions would play, now that these binary chemical munitions were being proposed. Congress passed legislation in November 1985 directing that for every binary munition produced, the Army would have to destroy a unitary munition. This led to the creation of the Army's chemical demilitarization program to destroy the 31,400 tons of chemical agents and munitions at the eight stockpile sites in the United States and the one at Johnston Island.

In 1987, the binary munitions facility at Pine Bluff started producing one of the two components of the 155 mm projectiles, ending a nineteen-year dry spell of chemical weapons production in the United States. The commercial firm that was to make the second component of the projectiles ran into production problems, preventing the formal completion of the effort. The Navy's Bigeye bomb had suffered a number of problems during operational tests, which had delayed the start of its production. The Army had canceled its requirement for 8 inch binary chemical munitions, having started to phase the 8 inch artillery system out of the inventory, and focused on its MLRS warhead design. Congress continued to debate the program's goals against the ongoing CWC talks in Geneva, calling for several General Accounting Office reports to monitor the binary weapons program.

In 1990, the United States and the Soviet Union agreed on a framework to accelerate the treaty discussions, and in June, they signed a bilateral destruction agreement that committed the two countries to begin disposing of their chemical weapons to bring their stockpiles down to 5,000 tons of agent by 2002. Part of the negotiations required the United States to cease its binary weapons program. Against the advice of the military, the administration of President George H. W. Bush agreed and directed the Army to stop all acquisition and test efforts in July. Thus the military's program never really reached its goal of modernizing its retaliatory capability; but many argue that without the program, the Soviet Union would have never come to the table to seriously negotiate in the first place.

The U.S. Chemical Demilitarization Program

President Ronald Reagan called for the resumption of the binary chemical weapons program early in his first term, and in 1985 Congress authorized the funding of that program contingent upon the disposal of the aging unitary chemical munitions, nearly 31,400 tons at nine stockpile sites. Could it be done safely, without harming the environment and without endangering the demilitarization workers or local populace? The Army thought the weapons could be safely disposed of, having researched and

executed various ways of disposing of chemical weapons for more than four decades. Congress had prohibited dumping the munitions in the ocean, and burial and open-pit burning were not options. The Army had examined chemical neutralization, but that technology had significant drawbacks and inefficiencies. So the Army chose incineration as the optimal technology to dispose of these weapons. The National Research Council agreed with this assessment, and the Office of the Secretary of Defense approved the decision.

Although the Army's tests showed that they could successfully build and operate an incineration facility that could dispose of 99.9999 percent of the CW agent and its associated materials, this program met with fierce resistance from a small number of national critics and at least two of the nine communities near the sites. In part, this resistance was because of the perception that the public had not been involved in the Army's decision-making process, and in part, politicians and the public were unwilling to believe the Army's risk management practices would keep them safe from exposure to chemical accidents. While the first plant was being constructed at Johnston Island, over 800 miles from Hawaii, Congress took on an increased role in directing the Army to conduct specific studies, to limit their options in executing the program, and to increase the participation of the public in its program. In the early 1990s, Congress directed the Army to examine alternative technologies to dispose of a portion of the stockpile. To the program's critics, this meant processes that would not use high-temperature technologies or open-air emissions.

Initial estimates of the total cost of the program over its life cycle was \$1.7 billion for a nine-year program (1985–1994). This early estimate was based on engineers' analyses and projections, and not based on any actual experience in building and running large-scale incineration facilities. It was not until the first disposal facility was built on Johnston Atoll that the Army could make a more refined estimate, in 1993, of \$8.6 billion. This life-cycle cost estimate increased to \$15 billion in 2000, was increased to \$24 billion in 2001, and could reach \$34 billion by 2012. The program's completion date has slipped from 1994 to 2004 to 2007, and it will be extended past 2012. Although this may seem like poor management, the fact is that the Army is running a disposal program that the Office of the Secretary of Defense oversees and Congress

directs. Over the program's life span, Congress has directed numerous additional studies of alternative technologies, excessive funding of emergency response programs for ten states, and the disposal of chemical weapons and material not in the stockpiles (discovered buried in the ground at old federal testing sites). These cost increases have been very similar to those of the EPA's Superfund program (the life-cycle costs for the Superfund program, initially outlined as a \$4 billion effort, are expected to reach \$28 billion for 1,250 sites).

Critics have accused the Army of inefficiency, of lying about the safety of the disposal process, and of inadequately investigating alternative technologies. The Army has stressed its safety and risk management record, which has resulted in the successful operation of seven disposal sites (and closure of two sites) without any harmful exposures to workers or local citizens to date (the remaining two disposal sites have not started operations yet). The General Accounting Office has agreed that cost and program slippages have occurred, but it notes that the requirements by Congress and state environmental oversight offices were just as much to blame for these slips as the Army's management. The EPA, CDC, and DHHS found that the Army's process was not only about as clean and as safe as it could possibly be but was also much more efficient than commercial or private incinerators. The National Research Council agreed that most alternative technologies have too many unknowns to be certified as better than incineration and should be employed at only two of the nine stockpile sites.

The Army steadfastly maintains that its program meets the congressional definition that it provide "maximum protection" to the environment, the demilitarization workers, and the public. Many residents around the stockpile sites have accepted the Army's program, although its critics continue to point to occupational safety concerns and reports of leaks as evidence that the Army has not chosen the right technology to dispose of these weapons and materials. Yet as late as 2002, the National Research Council identified the current incineration technology to be used at four of the eight U.S. disposal facilities as the safe and effective way to go, far outweighing the risk to the environment and public that would result from continuing to store the chemical munitions for years waiting for the perfect disposal technology to come along.

CB Warfare Agent Exposure after the Persian Gulf War

When President George H. W. Bush authorized military operations in response to Iraq's invasion of Kuwait, many in the Department of Defense were convinced that Iraq would use its CB weapons against U.S. forces. Iraq had clearly demonstrated a CW capability against Iranian forces between 1983 and 1988, meeting the Iranian human-wave attacks with chemical weapons and conventional military forces (Cordesman and Wagner 1990, 389). What was not known was whether Iraq had the capability to wage biological warfare, which had not been demonstrated against Iran. Iraq was suspected of developing BW agents, but the United States had no idea how sophisticated or mature that capability might be in 1990.

This military campaign is discussed more in chapter 7. The Department of Defense came under attack from veterans' groups and from the press immediately upon its initial claim that CB weapons were not used in the war and that U.S. forces were not exposed to CB warfare agents. Given the large numbers of Iraqi chemical weapons discovered after the war, the poor training of U.S. forces, their lack of confidence in their defensive equipment, and the U.S. population's own lack of faith in the government's investigations, it is not hard to understand these suspicions. The controversy over whether troops were exposed to CB warfare agents prior to or during offensive actions against Iraq has more or less been discounted by very thorough studies conducted years later. The controversy that remains is whether military forces were exposed to CW agents as a result of explosive ordnance demolition operations that occurred in March 1991.

As U.S. forces cleared the battlefield, the Army destroyed vast stores of Iraqi weapons and ammunition. One of these weapons sites was the Khamisiyah ammunition depot, south of An Nasiriyah in southern Iraq. This depot was a huge collection of warehouses containing tons of conventional ammunition, everything from rifle ammunition to explosives to artillery projectiles. Both explosives experts and CB defense specialists inspected the warehouses and failed to find anything other than conventional ammunition. In the course of destroying thirty-eight warehouses of ammunition on March 4, 1991, Army engineers unwittingly

blew up several stacks of 122 mm rockets filled with nerve agents sarin and cyclosarin. Less than a week later, they blew up stacks of 122 mm rockets in a nearby pit, rockets that were later determined to have been filled with nerve agents. Although no one was visibly harmed by the explosion or any apparent CW agent releases, later studies began to examine the possibility that U.S. forces had been exposed to less-than-lethal levels of nerve agents, released either by bombing Iraqi production and storage sites or by destroying these ammunition dumps.

In November 1995, Dr. Bernard Rotsker was appointed as the special assistant to the deputy secretary of defense for Gulf War Illnesses. His office spent several years and millions of dollars investigating claims of CB weapons exposure, studying medical analyses of returning veterans and funding follow-on investigations and studies to discover the source of the postwar illnesses. Although his office has concluded that there was no evidence conclusively showing CW exposure, their studies estimate that upwards of 100,000 personnel may have been exposed to low levels of nerve agents without their knowledge because of the Khamisiyah depot and pit explosions. The Gulf War Illness Office deliberately made this assessment overly conservative in an attempt to ensure that anyone who might have been exposed in 1991, no matter how insignificantly, would be warned and could take steps to address his or her medical condition (Mauroni 1998, 151–167).

As their low level exposure limit, the people modeling the hazard's parameters employed a general population limit measure used by the Army to protect people from occupational exposure to sarin nerve agent: 0.013 milligram-minutes per cubic meter ($\text{mg}\cdot\text{min}/\text{m}^3$). This measure is much lower than the recommended occupational exposure level for civilians who work in the chemical stockpile sites ($0.04 \text{ mg}\cdot\text{min}/\text{m}^3$), much lower than the incapacitating dose level of $2\text{--}3 \text{ mg}\cdot\text{min}/\text{m}^3$, and significantly lower than the lethal dose necessary to kill an adult human ($75\text{--}100 \text{ mg}\cdot\text{min}/\text{m}^3$). Three chemical dispersion models and two weather models were used to predict who in the downwind hazard prediction might have been exposed even to this very low level of nerve agent, and all troops who might have been in that prediction area for any part of a three-day period were counted and later notified. To be on the safe side, the modelers deliberately overestimated the purity of the Iraqi agent and did not consider the fact that the nonpersistent nerve agent would have been dis-

persed in the afternoon in a desert environment (the nerve agent probably would have not lasted three hours, let alone three days, in the heat). Because of these safe-sided assumptions, the actual number of people who might have been exposed to sarin is probably much, much lower than the estimate of 100,000. But the press, not appreciating the details behind the calculations, now report the incident as one in which more than 100,000 military personnel were exposed—not “may have been exposed”—to nerve agents. The 100,000 number has a life of its own, much like the 6,000 sheep “killed” by a nerve agent in 1968.

Several organizations still contend that CB warfare agents could have caused Gulf War illnesses, yet the lack of evidence from thousands of medical and CB defense specialists who were in the conflict and the many medical studies conducted since 1995 do not support these allegations. All the medical reports and investigations have failed to discover a linkage between potential CB weapons exposure and veterans’ illnesses. The conundrum is that no one will be able to disprove clearly that U.S. forces may have been exposed, since it is extremely difficult to study the effects of low levels of chemical agents combined with other battlefield conditions on people under controlled laboratory procedures. The best that can be accomplished is animal testing, which will always leave some level of doubt no matter how the conclusions come out.

Developing Medical Countermeasures against BW Agents

One of the controversial aspects of the Persian Gulf conflict was the use of medical countermeasures for chemical and biological agent exposure. This included the use of pyridostigmine bromide (PB) tablets as a pre-treatment and diazepam as a post-treatment for nerve agent exposure, and botulinum toxoid (to counter botulinum toxin exposure) and anthrax vaccine as BW agent pre-treatments. As already mentioned, the Department of Defense was convinced that Iraq would initiate CB warfare against U.S. forces once the offensive began. The lack of sensitive, near real-time biological detection equipment meant it could take U.S. forces days to recognize that they had been exposed to anthrax or botulinum toxin. Inhalation anthrax, in particular, is very deadly:

it is fatal to more than 90 percent of untreated personnel, and once signs and symptoms are visible (usually starting at forty-eight hours after exposure), medical treatment is useless. No other BW agent has this level of lethality and fast-acting effects. Combined with its ability to last for weeks to months in the environment and its ability to be spread over large areas, it is the megaton weapon in the BW arsenal.

The U.S. government had an anthrax vaccine that had received Food and Drug Administration (FDA) approval in 1970. This vaccine is a point of great controversy, since critics note that it was never tested against airborne-delivered, laboratory-developed "weapons grade" anthrax. However, this same vaccine has been safely and routinely administered to at-risk wool mill workers, veterinarians, laboratory workers, livestock handlers, and military personnel. Some people suffer side effects, but the overwhelming majority of side effects disappear after two days. About one in 200,000 persons suffers more serious side effects (Department of Defense 2003).

What was perhaps more controversial was the use of the botulinum toxoid, PB tablets, and diazepam autoinjectors (an anti-convulsant). These three drugs were not tested for their safety or efficacy in countering CB warfare agents prior to their use in the Gulf conflict. There were early tests that suggested the drugs would work, and there were related medical cases that suggested they were safe for administering to humans. There were no medical alternatives to using these medicines if troops were exposed to nerve agents or botulinum toxin, and the results of not using them were clear: many U.S. military personnel could die. The decision to use these products was carried out under an investigational new drug application, which would permit the use of drugs under the condition that the troops volunteered and understood the risk of taking them.

Whether U.S. personnel were apprised of the risks or whether they really volunteered is also a point of controversy. There was a war going on, and the implications of not taking the drugs if Iraq used CB weapons was pretty well understood. Many military unit leaders probably ordered their men and women to take the medications, in the interests of protecting their troops in the event of a CB weapons attack. Some critics have accused the U.S. military of using military personnel as "guinea pigs" in medical experimentation, which is contrary to public laws and would

be considered immoral. The idea that someone could give drugs to over 500,000 personnel in a fluid warfighting environment and hope to learn something is frankly ludicrous, but nevertheless there are those who persist in that argument.

In the 1990s, the Department of Defense and the FDA reexamined the challenge of developing medical countermeasures against CB warfare agents. After all, in the Gulf conflict they had only had the anthrax vaccine, and they felt they needed new vaccines for smallpox, plague, cholera, and other BW threats. They tried to work out procedures for how the U.S. government should approve pre-treatments, antidotes, and post-treatments for exposure to weaponized CB warfare agents when they could not test the drugs for efficacy and safety, as was done for commercial drugs. Between 1999 and 2001, the FDA initiated the development of protocols for using animal lab tests and other medical analyses to develop a basis for approving the release of these drugs (these protocols took effect in June 2002).

There are not many pharmaceutical firms that want to make military vaccines for BW agents. The threat of lawsuits, the insurance required, and the small quantities of vaccines produced (the military being the sole purchaser) make these BW vaccines unprofitable. This is not a problem unique to producing BW vaccines; many vaccine manufacturers that started up in the 1970s are going out of business instead of modernizing their equipment as a result of the stringent FDA approval process. The controversies over developing and administering vaccines in general, let alone for BW agents, has caused the market to stop production, creating a challenge that still has not been solved. The recent decision by the Department of Health and Human Services to build a national vaccine stockpile for responding to BW terrorism has led some of the pharmaceutical firms to show interest in remaining in production.

Knowing that adversarial countries are developing BW agents, how do we ensure that U.S. forces and the population in general can be medically treated if they are exposed while unprotected? The decision to use untested vaccines in the event of a BW attack, be it during wartime or during a terrorist incident, will be a difficult one. The lack of pre-treatment capabilities, combined with the limitations of current BW detection systems, poses a real challenge to both the Department of Defense and the Department of Homeland Security.

Military Response to Terrorist Use of CB Weapons

When the Aum Shinrikyo cult used sarin to attack Japanese civilians in the Tokyo subway in March 1995, it caused concern that terrorists could do the same in the United States. The Oklahoma City bombing, Atlanta Olympics pipe-bomb incident, and attacks on churches and family health clinics only highlighted the vulnerability of the U.S. populace. The incident in Japan led the U.S. government to revamp its Federal Response Plan, adding a section on terrorism response; it also directed the Department of Defense to start a Domestic Preparedness Program to develop emergency responder capabilities in case of terrorist employment of CB warfare agents. This training program for first responders (police, firefighters, medics, hazardous material specialists, and so on) was to take place in 120 major cities across the country. More than 100 cities received federal training courses and training equipment from the Department of Defense between 1997 and 1999, with the Department of Justice taking over responsibility of the program in October 1999.

Traditionally it has been the responsibility of the Federal Emergency Management Agency to support the plans and preparations of the state and local governments to respond to man-made incidents and natural disasters. The reason the Department of Defense was chosen to execute this training initially was largely because of the numbers of military experts who trained and equipped their forces to prepare for the CB warfare threat, which was unique from industrial hazards. Critics attacked the government's CB terrorism response program as a waste of money, arguing that too many federal agencies and industry consultants had gotten the money instead of the state and local responders. The program certainly did not ensure that every citizen would be protected, and smaller cities that were not among the original 120 cities complained that they needed the equipment and training as well. Although it is true that the program did not cover everyone, it was an initial effort to quickly disseminate critical information to first responders in those major cities where terrorists might be tempted to attack.

In 1995, General Charles Krulak, then commandant of the Marine Corps, believed that there was no adequate military asset prepared to support federal, state, and local responses to terrorist

chemical, biological, radiological, and nuclear (CBRN) incidents. At the time, the Army's Technical Escort Unit had the responsibility to advise federal, state, and local officials on aspects regarding CB terrorism and had the skills to disarm and move CB weapon devices that had not exploded. The Technical Escort Unit also supports the safe movement of U.S. CW material across the nation and the movement of chemical munitions that are unearthed during housing construction or cleanup of formerly used defense sites. However, this special unit did not have adequate personnel or the mandate to support the management of an incident after a CB weapon device exploded. General Krulak decided to fill that void with a special unit called the Chemical-Biological Incident Response Force (CBIRF) composed of more than 400 Marines and sailors that could advise the first responders, support the search and rescue of civilians in a hazardous environment, assist in decontamination and medical care, and stabilize the contaminated area.

The National Guard promoted the development of small federal response teams as a resource for state governors to call on in the event of a terrorist event, for many felt that federal response units, such as the Army's Technical Escort Unit or the Marine Corps' CBIRF, would arrive too late to offer any valuable assistance. Initially called Rapid Assessment and Initial Detection teams, they are now called Weapons of Mass Destruction Civil Support Teams (WMD CSTs) and were originally meant to be deployed one per Federal Emergency Management Agency region, or ten in total. This number grew (by congressional direction) to seventeen, then to twenty-two, and then (in 2001) thirty-two WMD CSTs were authorized. Congressional language in 2003 directed the creation of another twenty-three teams, for a total of fifty-five across the United States and its territories.

Following the events of September 11, 2001, the military has continued to define and outline its responsibilities in supporting federal response to a terrorist CBRN incident. The U.S. Northern Command has the mission to coordinate with the Department of Homeland Security on military support to civil authorities, to include deploying specific Army, Air Force, Navy, and Marine Corps subject-matter experts and units. The Defense Department is also concerned that terrorists might attack U.S.-based military installations and facilities with CB warfare agents and has taken measures to increase the plans and preparations at those bases to address this threat. Assistant Secretary of Defense for Homeland

Defense Paul McHale has suggested that the Department of Defense would lead, instead of support, any federal response to a terrorist CBRN incident. However, defense personnel and resources are largely focused on the traditional warfighting mission, and there are other federal agencies that are better equipped to lead and support aspects of the response to CBRN terrorism. In particular, the federal government remains concerned about the threat of biological terrorism, seeing this as a catastrophic incident that could require significant federal support. Because biological terrorism impacts most, if not all, of the public health system, the federal response is better led by agencies other than the Defense Department.

Developing a National Strategy for Bioterrorism

The threat of biological terrorism has created a unique challenge. It is safe to say that even the BW experts were surprised by the high quality of the anthrax sent and its ability to disperse among the U.S. mail delivery routes during October–November 2001. Although those letters could have been the work of an adversarial nation, the FBI suspected a lone individual with knowledge of the U.S. offensive BW program, based on the small quantities and the mail's targets (the Senate building and the *National Enquirer's* headquarters in Florida). Although many people were potentially exposed to the anthrax and had to receive ciprofloxacin (an antibiotic), only five people died as a result of exposure to anthrax in the letters. The perhaps unintended cross-contamination of other letters in the mail system created a panic across the nation, a panic that resulted in unscrupulous individuals peddling military masks and training manuals, not to mention dubiously validated surgical masks and glove box devices to ensure that one could safely open one's mail at home.

The question of what the U.S. government should do is receiving (and will continue to receive) a great deal of attention. Some have suggested that everyone in the United States should have a gas mask and be vaccinated in the event of another BW terrorist attack. Others have gone so far as to suggest that air purifiers and fans should be installed in office buildings and homes to minimize the chance of exposure. These ideas are more place-

bos than panaceas, as people would require a biological detector to warn of biological organisms and there would be no warning of exposure until days later, when they started getting sick. Although individual citizens must measure the possible risks of biological terrorism and take appropriate measures to protect themselves, the federal government has the responsibility to decide on the need for and shape of a public program to counter this public threat.

Biological terrorism requires more of a public health response than does chemical terrorism, which calls for a hazardous materials cleanup that is easier to monitor and address. Investing in the public health system and development of a national medical surveillance system may prove more valuable than masks and filters that people do not know how or when to use. An increased intelligence effort to identify what terrorist groups and nations are investing in CB warfare agents seems reasonable if the intent is to stop terrorists prior to using these dangerous hazards.

Treating the populace before or after a suspected BW attack remains a topic of great debate. The Department of Defense develops vaccines for use by a population of relatively healthy eighteen- to twenty-five-year-olds who are constantly monitored by medical personnel. These medical countermeasures were not developed or tested for children under eighteen or for older populations, as those populations are not represented in the military forces. The Food and Drug Administration approved the use of ciprofloxacin to treat civilians exposed to anthrax as off-label use (that is, the drug was not specifically designed for such use, but use was permitted because of a high probability that it would be effective), but the use of military-grade vaccines to treat the general population remains a controversial issue.

Another concern is the potential for terrorist attacks against the nation's crops and livestock. Imagine a terrorist group bringing hoof-and-mouth disease to Texas cattle ranches or disseminating a wheat stem rust or corn blight virus across Kansas. The effects of these attacks would be catastrophic to the agriculture industry and would considerably shake the U.S. public confidence in the government's ability to protect its food sources. Although industries can (and should) take steps to increase what is now being called "biosecurity" of their farms, the federal government has a role to play as well.

In April 2004, President Bush announced a "Biodefense Strategy for the 21st Century" (White House 2004). In addition to

outlining his administration's goals and strategy, this announcement included the mention of two particular programs: BioWatch and BioShield. BioWatch is an effort to place aerosol samplers in specific EPA stations around fifteen to twenty major U.S. cities, including Washington, DC; New York City; Houston; and Los Angeles. The purpose of these samplers is to allow the government to collect and analyze air samples every day for the presence of a BW agent that may have been deliberately released against the populace. The intent of this program is to allow the earliest possible warning of a terrorist BW attack, which would allow for prompt medical response. The cost of this sampling and archiving of data has not been stated, but must cost millions of dollars every month.

The BioShield effort is an attempt to obtain the pharmaceutical industry's support in developing and manufacturing medical countermeasures for CBRN threats. In 2004, the federal government dedicated \$5.6 billion to the research and development of these medical items over the following ten years. Because the major pharmaceutical firms had resisted manufacturing new vaccines for BW agents (primarily because of the threat of lawsuits, high insurance costs, and low profits), the bill creating BioShield also offered indemnification of the firms against legal actions resulting from the use of any medical countermeasures they might create. Despite the qualifications, the response to the program has been limited to small, young firms willing to take a chance in response to the financial grants. What is not often stated is the time required to achieve FDA certification that the new medical drugs will be safe and effective; often ten or twelve years are required to successfully attain this certification. In response, the secretary of the Department of Health and Human Services has the authority to order the use of untested medical countermeasures in response to any declared national incident of significance. To say this is controversial is an understatement.

Project BioSense is a separate but related effort being developed and executed by the Centers for Disease Control and Prevention (Centers for Disease Control 2005). Its intent is to reduce the lag time between the detection of a possible BW agent and the federal government's response by linking environmental data from Project BioWatch, epidemiological information from hospitals, reports from pharmacies, and other sources of information to a proposed Biointelligence Center. This center would examine all the data for patterns and anomalies that may not be apparent

through other means. This effort is still maturing, but it represents an important measure supporting the general surveillance of medical efforts across the country.

Critics of the government's biodefense strategy point out that more than one hundred thousand U.S. citizens die every year from normal diseases, such as influenza, HIV/AIDs, tuberculosis, cholera, diphtheria, Lyme disease, measles, and other infectious organisms. Instead of investing billions of dollars toward a possible terrorist threat that has a very low probability of ever occurring, these critics argue, why not invest in the public health infrastructure to save thousands of lives every year? This investment would also assist the government in addressing BW terrorism, as a more robust public health infrastructure would be better able to monitor and report on any abnormal outbreak of disease. The only challenge is that the government could not promise that it was ready to address BW terrorism, as the funds would be generally spent across the nation and not specifically to look for the major BW agents.

The U.S. government has invested and will continue to invest billions of dollars to ensure that there is a federal response capability for CB terrorist incidents. Although the United States may be vulnerable to CB terrorist attacks, the question remains: Is this really the most critical threat facing the populace? Many analysts feel that high explosives and conventional weapons will remain the most probable terrorist threat in the years ahead (Centers for Disease Control 2005). Besides the nebulous threat of terrorism, the very real threat of natural disasters (such as Hurricanes Katrina and Rita in 2005) and naturally infectious diseases such as influenza affecting thousands of people every year compete for the same federal resources and tax emergency preparedness efforts. Our emergency responders need to be thinking about and preparing for mass casualty events caused by CB warfare agents, but the common citizens on the street should not be thinking that they are always in danger from this threat. There have been far more lives lost to crime, conventional terrorism, and natural disasters, and that trend does not appear to be going away soon.

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3

Worldwide Perspective

The first chapter reviewed the reasons the United States had developed an offensive CB warfare program: largely to develop a credible retaliatory capability to dissuade its opponents (primarily the former Soviet Union) from attacking its forces with the same weapons. The Soviet Union and United States have not been the only two nations to develop chemical or biological weapons. More than twenty nations (depending on whose list one references) are suspected of having chemical or biological weapons programs or both, despite protestations by arms control advocates and other critics that CB weapons are immoral and ultimately inefficient. The reason for nations to seek these weapons is not as simple as wanting to own a "poor man's atomic bomb," as nations owning nuclear weapons are suspected of also developing CB weapons. Obviously, there are other reasons that drive these nations to acquire CB weapons.

Probably the most understandable rationale for a nation to develop CB weapons as an offensive capability is in response to the discovery that its neighbor is developing these weapons, especially if the neighbor is aggressive or the two countries have a history of religious or ethnic differences. Take Pakistan and India, for instance: although both have nuclear weapons capability, India has admitted to procuring chemical weapons, and Pakistan is suspected of having its own program (but has not admitted such). Because nuclear weapons represent a very final solution, if the two nations clash, they may seek to use CB weapons as a combat multiplier, each hoping to tip victory in a military conflict to its side without resorting to nuclear options. North and South Korea are another example of this traditional conflict, as are

China and Taiwan, Iran and Iraq, Egypt and Israel; all are suspected of having CB weapons programs of some degree and magnitude.

Another reason may be to create or bolster a sense of national pride in being able to develop military capabilities that rank with those of the superpowers. There is also the practical reason: military adventures can be very expensive if they continue too long, and CB weapons can considerably reduce an opponent's ability to defend itself. The ability to employ ballistic missiles capped with CB warheads allows a nation to threaten military forces from hundreds of miles away with little or no risk to its own forces. CB weapons can even cause the superpowers to hesitate to rush into a nation's neighborhood. For example, Iraq was able to stall the United States for six months in 1990 with the mere threat of CB weapons use, forcing the U.S. and coalition forces to rush huge stocks of CB defense equipment into theater prior to liberating Kuwait.

A considerable number of nations are suspected of having CB weapons, based on official sources or on an author's research at that time. Usually these reports will use terms such as "confirmed," pretty self-explanatory; "probable," the nation has shown enough interest that it appears to have scientists developing agents and engineers developing weapon systems, but it has not used them in combat; and "possible," the nation has the technology to develop the weapons, its scientists may have written a few papers on the topic, and it has a motive to promote a CB warfare program. The mere fact of having the technical capabilities (industries that can produce toxic chemicals in large amounts and laboratories that can develop pathogens and toxins) does not mean a country is developing an offensive CB warfare program, but, combined with other factors, it may be an indication of intent.

The only nations that have "confirmed" past chemical and biological weapons programs have been France, Russia, the United States, the United Kingdom, Libya, and Iraq. Albania, India, South Korea, and Yugoslavia have admitted to having chemical weapons stocks but have declared their intent to destroy them under the Chemical Weapons Convention (CWC). China, France, Iran, Japan, the United Kingdom and South Africa have stated they once had chemical weapons but destroyed all their stocks prior to signing the CWC. The former member states of the Soviet Union had some CB weapon stocks or chemical weapon production facilities; they either returned these stocks to

Russia or asked the United States for assistance to destroy them. Although no nation admits to having an active biological weapons program, a number of nations are suspected of doing so, treaties and statements to the contrary.

An examination of most countries' programs reveals a predictable pattern in the development of CB weapons. A country lacking nuclear weapons starts with chemical weapons and graduates to biological weapons. Chemical weapons are relatively safer to handle and easier to develop, assuming that the host nation already has the technology and resources to develop industrial chemicals in mass quantities. After researching and developing specific CW agents, the next step is to weaponize and test the delivery systems out in the field. Most modern nations can easily develop mustard agents and nerve agents, for there is plenty of scientific literature on their structures and formulation. After gaining this experience, a nation may feel emboldened to take the next step to researching, developing, and producing BW agents. If they pattern their programs after the former offensive biological weapons program of the United States, they start with the low-casualty causing agents such as brucellosis and tularemia, before going on to such "big guns" as anthrax, plague, and smallpox.

Although there may be many motivations for nations to develop military capabilities, there is still a great deal of question of what chain of logic drives a nation's leadership to desire an offensive CB warfare capability in the first place. In a thesis prepared for the Joint Military Intelligence College, Lieutenant John Dahm postulated that there may be an analytical framework to the decision-making process that a nation undertakes involving the acquisition and employment of CB weapons (Dahm 2000). He believed that national decision makers had to develop a certain mentality that would lend itself to integrating the concept of employing CB weapons into their national political and military thinking. This mentality requires being pushed to the point of rejecting international norms prohibiting CB warfare and overcoming any natural psychological aversions to CB warfare use, thus bridging a "psychological threshold." For example, does the political leadership willingly choose to develop CB weapons because of a desire to gain international recognition of the nation's military capability or to cow its neighbors into passivity? Or does the leadership feel forced by circumstances into developing these weapons because its neighbors are developing CB weapons?

Once the leadership accepts the need for an offensive CB warfare program, the military leadership needs to identify what threats or requirements could be addressed with CB weapons—where CB weapons would address a particular battlefield application better than conventional or nuclear munitions. The key decision points may include the military leadership's seeing that use of CB weapons will succeed where use of conventional munitions has failed, potential strategic costs, enemy vulnerabilities, and the odds of being defeated if these weapons are not used. Once they have identified these requirements, the military leaders have crossed the "operational threshold" and have begun a serious pursuit of a CB weapons program. This leads into the science, engineering, and development of military weapons, and initiation of military training required to turn that nation's intent to develop CB weapons into a true military capability.

Because of intelligence concerns and a desire of most countries to maintain secrecy about their offensive CB warfare program, to examine each country analytically through this framework may be difficult, but it is an interesting thesis to use. The number of nations seeking CB weapons has steadily increased since World War II, and few have ended their programs. It may be instructive to examine why these nations are interested in developing weapons that have been called horrible, immoral, and ineffective, and when nations make the transition from having a capability to build a program to having the intent to wage CB warfare. An excellent reference source for the CB weapons histories of nations is the Monterey Institute of International Studies' Chemical and Biological Weapons Resource Page.

The following discussions have been derived from various references identified in chapter 9.

Europe

At the beginning of World War I, no nation was actively seeking a chemical warfare capability, although some scientists and military analysts had suggested the possibility. The decision to employ gas munitions came as a result of deadlock caused by trench warfare. As the two sides hunkered down, gaining ground became very difficult and very expensive in terms of human lives, resources, and time. When the German army employed chlorine

gas at Ypres in April 1915, it gained only a few miles against the Allied forces, but that was much more than other campaigns had so far achieved. Although the Germans retained a technological lead over the British and French throughout the war, all three nations invested heavily in this new form of warfare. At this point in history, chemical weapons were not considered "weapons of mass destruction," but they did play a significant role as tactical weapons. Specifically, chemical munitions allowed one side to demoralize its enemy by forcing them into uncomfortable protective masks for hours, to disrupt hostile artillery batteries, and to diminish the enemy infantry's capabilities prior to the infantry advance (Palazzo 2000, 72).

Once gas warfare was demonstrated to have an impact on a particular battle (promising to break the deadlock of trench warfare), the British, French, and German armies began to identify what chemicals they would employ (phosgene, cyanogen chloride, and so on) and how to employ them (cylinders, projectiles, and artillery shells) on the battlefield. Industries in all countries manufactured thousands of tons of chemical agents, and the use of gas became a standard practice in battles. The British army formed a Special Brigade within its Royal Engineers branch as their technical and operational specialists, in addition to employing artillery-delivered gas munitions. The German Army also called on its engineer brigades to deliver gas at specific points on the battlefield.

Although the initial troops came from the engineers, the American Expeditionary Force quickly developed a Gas Service to focus its efforts. Because the Americans had come into the war late and had not developed any chemical weapons, they relied on loans of British Stokes mortars and Livens projectors and French 75 mm artillery as chemical weapon delivery systems. The British loaned masks to the U.S. Army and trained many of the American troops going into battle. An interesting note is that many U.S. commanders did not necessarily want to execute gas attacks, in part because they felt that using gas in an attack would increase the odds that the Germans would retaliate with gas against them. This might be interpreted as the U.S. forces' failing to cross what Dahm called an operational threshold. The Germans used gas against U.S. positions anyway, whether the Americans withheld their gas or retaliated. The British, French, and Germans, having been locked in a deadly and vicious seesaw battle for years, had fewer illusions. They were willing to use

these weapons to gain any combat advantage that would gain territory and avoid the losses and devastation seen so far.

Following the war, many analysts downplayed the military significance of gas warfare, claiming it had never lived up to its creators' expectations. In part, this was true. Gas attacks on their own had not changed the war's outcome, but for that matter, neither had the tank or military aircraft, also born in World War I. Gas demoralized the troops upon which it descended, allowing the attackers to gain some tactical advantages. By delivering gas against enemy artillery batteries, one could reduce the number of barrages and gain some local superiority in firepower. These advantages were often not enough in cases where the enemy was too evenly matched in the number of troops and given the intricate, interlocking trench designs. It did, however, allow the Germans to repulse Russian attacks in the east and to assist Austrian forces in breaking the Italian forces in the mountain passes at Caporetto (Gilbert 1994, 346–347, 351, 369). Following the end of World War I, Italy and Japan encouraged the fear of chemical warfare proliferation by their pioneering use of CB weapons. Italy was facing Ethiopian forces that were fighting on their own terrain, using the mountains and desert to their advantage and threatening to delay the Italian conquest of that nation. The Italian forces used mustard bombs against the Ethiopians in the mountains and in the rear areas, disrupting the supply columns of donkeys and barefooted men. Conventional munitions would not have caused the sudden collapse of resistance quite as quickly as the mustard bombs did; some analysts estimate that it reduced a multiyear campaign to eighteen months. Despite pleas to the League of Nations for assistance, the Ethiopian forces received no relief. Although Italy had the capability and training to use these same chemical weapons against the Allies, they never did, perhaps because of the fear of retaliation that President Roosevelt promised if the Axis powers were to use chemical weapons against U.S. forces. (See below for Japan.)

In World War II, Britain, France, and the United States all armed themselves with significant quantities of CB weapons in the fears that Germany, Japan, and Italy would instigate CB warfare against the Allies. While the three Axis countries had initiated their own chemical weapons program, actual CB warfare never happened. Instead, these stocks were moved from theater to theater as potential retaliatory weapons. Although some believe that Hitler's gas warfare experience in World War I was a

reason that he never pushed for the use of nerve agents, that view is overly simplistic. As Dahm has pointed out, a nation's leadership and military force need to be pushed over the operational threshold to use these weapons. For both Germany and Japan, conventional forces were adequate to gain victories in their respective theaters for some time. Tactical operations and logistics priorities weighed against the chemical weapons option. Germany in particular had no desire to slow down its blitzkrieg with the use of chemical weapons and accompanying need for protective masks and suits to protect its soldiers against retaliatory strikes. Germany's military leadership had fought in the previous war and they realized that initiating chemical warfare could bog down into trench warfare, which they could not afford. And once the Allies gained air superiority, the German leadership recognized that their cities would be at risk from enemy gas attacks if they were to use CW agents against the invading forces, and so chose to refrain despite being against the ropes.

Following World War II, the United Kingdom and France did continue their research into CW agents, especially with the discovery of nerve agents. In the 1950s, both nations abandoned the development of chemical weapons, in part because of the heavy U.S. military presence shielding Europe from aggression and in part because of the cost of developing a new set of weapons (Harris and Paxman 1982, 179). However, these two nations continue strong CB defense programs to this date. All the European countries and the United States have signed and ratified the Biological Weapons Convention (BWC) and the CWC. The United States, having an ample budget and competing with the Soviet Union, continued to develop a retaliatory chemical weapons capability up to 1990, but its military and political leadership did not believe in using CB weapons in other than a retaliatory capability. It was a strategic card intended to keep the Soviet's weapons off the table. The Soviet Union, also signatories of the BWC and CWC, had different motivations.

The Former Soviet Union and Russia Today

Russia had suffered greatly in World War I, with more deaths from gas weapons than all the other countries combined and more gas casualties than Germany and France combined. Developing a

chemical warfare program was not just a desired capability; it was a necessity if the Soviet Union was to fight another war. Part of the increase in capability came as a result of German scientists using Russian facilities and resources in the mid-1920s. Although the Germans were primarily interested in retaining their world-class industrial chemical status, the Soviets gained knowledge as well. This alliance did not last long. The Germans were more open about their mobilization for war in the 1930s, and they soon abandoned their Soviet colleagues to openly continue their research in Germany. At the beginning of World War II, the Soviet military had a healthy ongoing offensive CB warfare research effort and a considerable defensive capability. This capability was soon wiped out by the early successes of the Germans in 1941. Although the research efforts could be relocated, the defensive equipment and troops were lost.

There is some speculation that the Soviets did employ tularemia against the German military operating in southern Russia in the summer of 1942. Large numbers of German troops suddenly came down with the disease—so many that their campaign temporarily came to a halt. Unfortunately, more than 100,000 Russian soldiers and civilians also contracted the disease. This unprecedented spike in tularemia casualties was not likely to have occurred naturally (Alibek and Handelsman 1999, 29–30). The impetus for the Soviet Union to develop a CB weapons capability was very clear: for the second time in the twentieth century, it was fighting for the Motherland and losing millions of soldiers and civilians to the German advance. Conventional weapons were barely enough to stem the tide this time, and even that only because of liberal supplies of weapon systems and equipment from the United States.

Following World War II and into the Cold War, the Soviet Union worried that the United States was surpassing it in CB warfare capability. In 1956, the Soviet defense minister, Marshal Georgy Zhuhov, commented that they had to be capable to fight in future wars that included the use of “weapons of mass destruction.” Although many analysts chose to interpret that as the Soviet Union’s intent to develop these weapons, from the Soviet perspective, it was an expression of their concern that CB weapons would be used against them and thus of the need to balance the scales. This concern led to a very robust science and engineering effort at dozens of facilities across the country.

Interestingly enough, the Soviet scientists developed many of the same biological weapons and delivery systems as the United States had, and they conducted similar large-area tests between 1960 and 1980. Unlike the United States, they did not limit themselves to weaponizing noninfectious lethal agents, exploring agents such as smallpox, Marburg virus, and others (Alibek and Handelman 1999, 42–43). When President Nixon made his announcement in November 1969 officially canceling the U.S. offensive biological weapons program, the Soviet leadership did not believe the United States would be so foolish as to halt research on such an effective weapon system. They felt assured that the United States would not abandon the results of millions of dollars in past investments and the hundreds of civilian researchers would not just stop working. The U.S. offensive BW program had, in their minds, just gone underground (Alibek and Handelman 1999, 234–235).

Soviet production would eventually reach the capability to produce and store literally thousands of tons of BW agents per year. The program was huge and not limited to developing "weapons of mass destruction." Soviet-supplied ricin was used in an assassination of Georgy Markov, a Bulgarian defector in London, in September 1978. In April 1979, at Sverdlovsk, a worker failed to replace a large filter correctly, resulting in a release of pulmonary anthrax spores that killed more than 100 civilians in the town. The incident was initially dismissed as gastrointestinal anthrax; it was not until 1992 that the Russian government admitted that the "gastrointestinal anthrax" incident had been an anthrax production plant accident.

When the Soviets invaded Afghanistan, they brought a large contingent of their chemical warfare specialists into the country. Because conventional munitions were not retarding the Afghan rebels' actions sufficiently, the Soviet military turned to chemical weapons as being more effective. U.S. government reports allege that the Soviet military forces used chemical weapons between 1979 and 1986 against mujahideen rebels, using first mustard and nerve agents, and then graduating to "yellow rain"—trichothecene mycotoxins—and other experimental CB warfare agents. Whether the Soviets previously experimented with "yellow rain" in Laos in the 1980s is still debated (Evans 1983). In 1986, reports of Soviet chemical weapons attacks dropped off, perhaps because the attacks were not seen as being very effective on the well-hidden rebel

forces. The Soviets had also shifted to mass bombings with incendiaries and better designed bombs that may have been more effective than CB weapons (Cordesman and Wagner 1990, Vol. III, 214-218).

Following the break-up of the Soviet Union, President Boris Yeltsin officially called for the end of his country's offensive biological weapons program. The U.S. Cooperative Threat Reduction program is intended to help Russia and former Soviet Union nations disarm their nuclear, biological, and chemical warfare production factories and associated weapon systems. Some people are still concerned that the thousands of unemployed researchers might be tempted to assist smaller nations develop their offensive CB warfare programs, thus proliferating the threat across the world. Although this may be a reasonable concern, certainly many countries are able to research and develop these agents on their own today, given that the technology and knowledge required to build these facilities are no longer state-of-the-art.

As a side note, the former Warsaw Pact allies benefited from their association with the Soviet Union's offensive CB warfare program. Romania, Bulgaria, and the former states of Czechoslovakia and Yugoslavia all either had indigenous means of manufacturing chemical weapons or had stored Soviet chemical munitions in their countries. While these countries no longer have active programs (having signed the CWC), they had the knowledge and capability to develop these weapons, and they had motivations much like those of Russia. As a result, they all developed strong defensive capabilities using Soviet equipment and training. In fact, the Czech Republic now works closely with the United States, United Kingdom, and the Netherlands on chemical defense research issues.

East Asia

In East Asia, a number of countries have traditionally been in conflict for decades, if not centuries. Prior to Japan's military ambitions in World War II, China had clashed with Vietnam, Korea, and Japan. Thailand, Singapore, Malaysia, and Indonesia have all had their clashes, internally and externally. These powers have developed their respective military capabilities with a careful eye on each other. Part of this history has included the development and testing of CB weapons.

Japan's early efforts investigating biological warfare are well documented; history has noted not only its research and experimentation in Manchuria in the 1930s but also its failure to develop biological weapons and use them effectively (Williams and Wallace 1989). By the late 1930s, the Japanese were producing CW agents and weapons and had initiated a BW research program under the name Unit 731. The Japanese researched several BW agents and used prisoners of war as research subjects, eventually weaponizing some BW agents for use against Chinese cities. Between 1937 and 1942, Japanese forces employed riot-control agents, phosgene, hydrogen cyanide, and mustard agents in tactical battles against the Chinese military. Although the Japanese regarded chemical weapons as legitimate battlefield weapons in World War II (they had not signed the Geneva Protocol), the use of chemical weapons was not the major factor in winning these battles (Croddy et al. 2002, 154–155). The Japanese government developed about 8,000 tons of CW agents during World War II, as compared to the U.S. government's production of 146,000 tons of CW agents during that same period. In the face of steady U.S. victories and the slow collapse of their forces, the Japanese military hurled kamikaze pilots into combat, but not CB weapons. The threat of American retaliation against Japanese cities, combined with the lack of their CW munitions' efficacy seen in China, may have held the Japanese government from authorizing CB weapons attacks against Allied forces. Although both the Americans and Soviets sought out the Japanese researchers and their efforts after the war, what they found was somewhat less than anticipated and did not do much to advance the superpowers' efforts. Since World War II, Japan, like Germany, has not invested in any offensive CB warfare program. The Japanese have increased their defensive capabilities, notably since the Aum Shinrikyo use of nerve agent in the Tokyo subway in 1995. Japan has signed both the BWC and CWC.

The Korean conflict did not include any CB warfare, despite claims from China and North Korea to the contrary. Here again, however, is a case where the countries involved—North Korea, South Korea, and China—see that the use of conventional munitions alone may be insufficient to advance their desired military goals. North Korea is believed to have been developing an offensive CB capability since the 1960s and it has the capability to produce and weaponize these agents in large quantities through its indigenous chemical industry. North Korea can deliver these

agents through artillery systems or aircraft, but the real concern is whether it has mated its CB warfare capability with its ballistic missile program. Ballistic missiles, developed in part from old Soviet technology and research assistance, pose a real threat not merely to North Korea's neighbors but to U.S. forces in theater. Although North Korea has acceded to the BWC, it has not signed the CWC.

North Korea's motivation to invest in an offensive CB warfare program can be tied directly to its perspective that the United States is the aggressor against smaller countries and to its feeling that it requires a significant capability to prevent the United States from interfering with its interests. As the U.S. military has nuclear weapons and has demonstrated the will to use them, the North Korean government sees unconventional weapons as the key to counter that threat (Lavoy et al. 2000, 183). The Iran-Iraq War demonstrated the utility of chemical weapons, causing a renewal of interest in developing an indigenous production capability. North Korea's military regularly trains in chemical defense operations, being told they should expect South Korea and the United States to employ chemical weapons against them. Chemical agents—estimates of 2,500 to 5,000 tons—added to the country's ballistic missile program give the North Koreans what they feel is a tactical edge against a well-trained and equipped South Korean military and the U.S. forces in theater.

The continuing threat of a North Korean "first attack" intended to reunite the two Koreas is a threat not merely to the South Korean populace and to U.S. forces, but also to Japan, which supports U.S. military efforts in the area. The growing range of North Korea's ballistic missiles puts Japanese cities and U.S. military forces in Japan at risk. North Korea has also sold ballistic missiles and related technology to Pakistan and other countries as a source of hard currency, increasing the potential use of CW-tipped ballistic missiles throughout the world.

In addition to its nuclear weapons program, China is believed to have begun developing a chemical weapons program in the 1950s, and it has the industrial infrastructure and technical expertise to have started a biological weapons program. China's military also patterns itself after the Soviet model, with similar artillery, rockets, aircraft, and ballistic missiles that can deliver CB warfare agents. Communist Albania imported sixteen tons of mustard, lewisite, and adamsite bulk agent (not weaponized) from China in the 1970s and 1980s, ostentatiously to defend itself

against potential Soviet or American attacks (These munitions were found in a bunker in 2004, and the United States is assisting in their destruction.) (Warrick 2005). China's industry and military forces have grown to rival the industrialized powers of the West. The United States believes that China's declarations of never pursuing a biological weapons program are "inaccurate and incomplete" and that it does have a moderate arsenal of traditional CW agents (Cohen 2001). China has, nonetheless, signed and ratified the CWC and acceded to the BWC.

China's programs and motivations to develop an offensive CB warfare program are not as clear as those of North Korea or other nations. China is certainly not seeking a "poor man's atomic bomb," given that it has a mature nuclear weapons capability. One reason that China may be at least investigating CB warfare agents is that it may believe that Taiwan has developed CB warfare agents of its own and that it needs a defensive and retaliatory capability (a position much like the U.S. position with respect to the Soviet Union in the 1980s).

Taiwan is on some military analysts' lists as a nation that has the potential to have developed CB weapons. Certainly it has the technology, a strong manufacturing capability, and the motivation. Since the nationalist Chinese army retreated to this island, Taiwan has been under the watchful eyes of the People's Republic of China. If the mainland Chinese military decided to invade Taiwan, the small island would not be able to resist with conventional munitions alone and without United States assistance. There have been persistent reports since 1989 that Taiwan has, at the least, manufactured CW agents for researching defensive measures. The government has denied having an offensive biological weapons program but does admit to having a robust CB defense program (FAS 2003). Although the leadership may be considering offensive CB warfare measures, it is unlikely that their military has been able to train to use these weapons (given the size of the island). Taiwan has acceded to the BWC but has not ratified the CWC because of its non-nation status in the United Nations.

Vietnam makes the Congressional Research Service's (CRS) list for chemical weapons primarily because of its past association as a suspected testing ground for Soviet CB weapons such as the T2 mycotoxin—mustard and nerve agents employed against Hmong tribespeople and Laotians in the 1970s (Shuey 2001). Vietnam's military is not believed to have retained an active offensive

CB weapons program. Vietnam has acceded to the BWC and ratified the CWC since then. Myanmar (formerly known as Burma), Indonesia, and Thailand all make the CRS list as well, but mostly because of the possibility that they may have ownership of old stocks abandoned by the British forces during World War II. All three have signed the BWC and CWC.

South Asia

Both India and Pakistan have invested in chemical weapons programs at the least and are believed to have investigated biological weapons to some extent. The exact year that these countries started their programs is unclear, but it probably would have been in the 1960s or 1970s at the latest. Both have signed and ratified the BWC and CWC; India in particular declared that it had an offensive chemical weapons capability that it would demilitarize. Pakistan has not declared any chemical weapons stocks and it continues to develop its chemical industries in areas that could be considered useful for developing chemical weapons. The continued instability in that region, caused in a large part by disagreement between India and Pakistan over control of the Kashmir region, has kept tempers hot.

Both countries have the technology and inherent resources to develop offensive CB weapons, but both claim to have focused on defensive programs only. Both sides have a great deal of investment in advanced military equipment, including ballistic missiles and nuclear weapons. There is probably little chance that they will put down their nuclear arms in the near term; the desire to retain those weapons as a hedge against full-scale war may be the reason that these nations have agreed to abandon offensive CB weapons. Both have significant conventional forces, but neither can afford to neglect researching what the other may be planning to employ. The hard-liners in both governments will probably ensure that these two countries remain at high military alert for the foreseeable future.

It is probably easier to understand why Pakistan would invest in offensive CB weapons, for its infantry forces are outnumbered five to one and outgunned three to one in tanks and artillery when compared against Indian forces. Although nuclear weapons may be Pakistan's last line of retaliation in the event of a full-scale invasion, nuclear weapons do not help in the numer-

ous smaller conflicts that continue to occur between the two nations. Pakistan may see CB weapons as the way to counter the larger Indian forces, much as Iraq held off superior Iranian numbers in their conflict. India's concerns about a growing Chinese influence in their region, added to the existing friction over the Kashmir region, were probably its justification for initiating an offensive CB warfare program. India has a mature scientific and industrial capability that could support research and development of its own offensive weapons, if need be. It was the first of the two to declare that it did have a dedicated CW production capability and that it would disarm, a declaration that might have been in recognition that its conventional superiority in the area negates the need for an offensive CB weapons program, although India continues its defensive CB program.

The cases of Pakistan and India again demonstrate that CB weapons are not merely "poor man's atomic weapons," since neither country is relying on CB weapons as a surrogate for nuclear weapons. CB weapons have a clear and distinct use between conventional and nuclear weapons for these (and other) countries. The label "poor man's atomic weapons" is more of an arms control community attempt to believe that countries seek CB weapons for the same reasons that they seek nuclear weapons.

Middle East and Africa

The Middle East has been and remains the hottest region for potential CB warfare conflicts. This may not be a surprise to most military analysts and even the general public, considering the number of conflicts going back decades in this region. Israel has signed but not ratified the CWC, has not acceded to the BWC, and does not participate in the Nuclear Non-Proliferation Treaty (NPT). It is suspected of having an offensive chemical and biological weapons program, and it may have used nerve agents to attempt an assassination of a Hamas leader in 1997 (Gellman 1997). Given its CB warfare capabilities, combined with its nuclear weapons program and ballistic missiles, Israel is a country that in its efforts to be secure from invasions from its neighbors has developed a very sophisticated unconventional weapons program.

Like Pakistan, Iraq, and Taiwan, Israel developed these capabilities because it can be outnumbered and outgunned by its

Arab neighbors, as has been the case several times in the past. Although Israel's military may have superior technology and highly trained military personnel, not to mention the support of the United States, the sheer volume of military forces invading from the north, east, and south could overwhelm the Israeli military despite its superior conventional weapon systems. Needless to say, Israel's neighbors are developing their own offensive CB weapons in response, which in turn spurs on the Israeli efforts to develop at least a retaliatory capability. Because of these threats, Israel has a very highly organized homeland security organization that distributes protective masks, medical countermeasures, and shelter-in-place kits to its citizens.

Egypt's chemical weapons program came to light when Egypt was involved in the 1962–1970 Yemeni civil war, supporting the republican forces against the royalists. The Soviet Union is believed to have supplied nerve and mustard bombs to Egyptian forces, causing more than a thousand casualties when Soviet-supplied Egyptian bombers dropped chemical bombs on Yemeni royalist forces. In the 1973 Arab-Israeli war, Israeli forces captured Egyptian soldiers with protective masks and chemical antidotes and Soviet-supplied armored vehicles with collective protection equipment.

It is believed that Egypt, in particular, has continued to upgrade its CB warfare capabilities because it sees that obtaining nuclear weapons is not feasible. It therefore has both rationales and incentives for continuing its research and development efforts in this area. The rationales include its assessment that Israel has a mature offensive CB warfare capability; that other Arab countries in the Middle East are seeking these weapons, and there needs to be a balance of power; that Egypt should continue to be a leader, strategically and militarily, in this region; that CB weapons have a significant strategic and military value and contribution; and that Egypt has the technical capability to sustain and enhance this unconventional capability. It continues to refrain from signing the CWC (Shoham 2003). Egypt has the potential to develop CB warheads for its ballistic missiles, although no one is sure whether it is actively seeking this capability.

Egypt denies having an offensive CB warfare program today, and it has acceded to the BWC but refuses to sign the CWC as long as Israel has not participated in the NPT. Iraq, Libya, and Syria followed Egypt's example. Military analysts believe these nations may have developed CB weapon programs to counter Israel's sus-

pected offensive CB warfare and nuclear programs, especially seeing that they cannot develop nuclear weapons—yet. In addition, in an area where every state is developing CB weapons, no state wants to be the one in this volatile region without them.

Syria has signed but not ratified the BWC, and it also refuses to sign the CWC. Syria is believed to have the most sophisticated CW program in the region, one that started in 1973 with Egypt sharing its chemical weapons as Syria's ally in the Arab-Israeli war. After 1982, Syria was seen as increasing its NBC weapons training. The Syrian military has equipment similar to that of Russia and is believed to have tested ballistic missiles with CW warheads. Its chemical capability includes Scud and Frog missiles in addition to cluster bombs and modified incendiary munitions. Although it has an impressive arsenal, Syria is probably the only Arab nation that has an offensive CB warfare capability but has not used CB weapons in a military conflict.

Syria has an indigenous chemical precursor capability, a strong industrial infrastructure, and at least three CW production facilities. Although this nation has the infrastructure to support an offensive BW program, there is no clear evidence that it has done anything other than limited research (NTI 2003). However, other sources believe the Syrians have been seeking to develop a BW capability since at least 1988 (Cordesman and Wagner 1990, Vol. I, 282). Although President George W. Bush did not add Syria to his "axis of evil" (Iraq, Iran, and North Korea), it certainly ranks as a country that has both "weapons of mass destruction" programs and connections to terrorists.

Iraq and Iran used chemical weapons against each other in the first Gulf War between 1983 and 1988. This conflict is described in more detail in chapter 7. Iraq began developing its CW program in the 1970s, using European materials and equipment, and by the 1980s, it had a fairly substantial program. Starting with mustard bombs and graduating to nerve agents, Iraqi military forces were able to beat back Iranian human wave attacks that were threatening to overwhelm them in the south. Again, the main motivation was that conventional munitions were not sufficient against the larger enemy numbers. Although Iran tried to develop an offensive CW capability later in the war, it was never as successful as Iraq had been, given its lack of a modern chemical industry and the necessary technology to develop these weapons. Both sides had ballistic missiles, but neither had developed chemical warheads during their conflict (Cordesman and Wagner 1990, Vol. II).

Iraq has used chemical weapons in combat and to terrorize its own populace but has not demonstrated any operational BW capability. That does not mean it was not developing an offensive capability. When the United States prepared to attack Iraqi forces in the spring of 1991, there was a great deal of concern about whether Iraq would use CB weapons to counter the coalition forces. Six months of training and stockpiling CB defense equipment gave coalition forces some confidence that they would at least survive any Iraqi attacks. Air superiority, a heavy offensive against suspected production and storage sites, and strong attacks against Iraqi artillery and air systems also limited the chance of Iraqi CB warfare attacks. Fortunately, it appeared that Saddam Hussein had used his CB warfare capability as more of a bluff, and U.S. forces returned without having been engaged in CB warfare (Mauroni 1998).

Between 1991 and 1998, Iraq resisted the efforts of international arms control experts to identify and eliminate its offensive CB warfare program. The United Nations Special Commission (UNSCOM) tried to penetrate Iraq's special weapons programs for seven years, with only limited success (Ritter 1999). UNSCOM did clarify what Iraq had developed in the way of offensive CB weapons, but it seemed that Iraq was holding back information on current stocks. UNSCOM installed automated monitoring systems at known facilities, but without being maintained, these systems eventually ceased to operate. Between 1998 and 2002, Iraq refused to allow United Nations inspectors into the country, leading President George W. Bush to threaten offensive action if Iraq did not allow the inspectors' return and live up to the terms of the 1991 cease-fire agreement that specified it would eliminate all of its unconventional weapons.

The United Nations prevailed upon Saddam Hussein to allow new inspectors, the UN Monitoring, Verification, and Inspection Commission, or UNMOVIC, into the region in November 2002. While the UN inspectors found no evidence of a renewed CB weapons program, the Bush administration, citing intelligence information culled in part from Iraqi dissidents, decided to overthrow the regime because of the combination of Iraq's WMD program, its connections to terrorist groups, and the potential threat to U.S. citizens that might result. Following an invasion in March 2003 and subsequent occupation of the country, U.S. military and arms control inspectors have been unable to find any evidence of Iraq's rebuilding an unconventional weapons

program (although scattered chemical munitions built prior to 1991 were found).

Iran's efforts to develop offensive CB weapons started in the Iran-Iraq war, largely in an attempt to retaliate against Iraq's first use of such weapons. Although analysts believe that Iran employed chemical weapons against Iraq (although without much effect), Iran has never admitted to such. Iran has claimed that it no longer has an offensive CB warfare program and has ratified both the CWC and BWC. Military analysts believe its program could still be active, given its history of conflict with its neighbors. Iran receives a good deal of support from Russia and China, including production technology and expertise in chemical and biological manufacturing that could be used to create an advanced and self-sufficient military CB warfare capability. If Iran continues to build up its industry and expertise, it could resume its offensive CB weapons programs, which is one reason that President Bush included the nation on his "axis of evil" watchlist.

South Africa was developing chemical and biological weapons in the 1980s and into the early 1990s, a program that was not exposed until a few years ago. In the early 1940s, South Africa had manufactured mustard gas for the British military in anticipation of its use in World War II. Following the war, the government dumped these stocks at sea. Despite having signed and ratified the BWC, the South African government began research on how to develop CB weapons in the 1970s. With civil wars erupting around it and feeling an increasing sense of isolation, the government began a partnership with Israel on armaments development, which may have included CB weapons technology (Burgess and Purkitt 2001, 1-6). Following the change of governments in 1994, South Africa disestablished its offensive CB warfare program, in part as a result of increasing pressure from the United States and United Kingdom. South Africa has also signed the CWC, as have more than forty other African nations.

South Africa is another example of a country that built nuclear weapons in addition to CB weapons. South African forces did not employ CB warfare agents against guerrillas or its neighbors, as it has a very well trained and equipped conventional force that was able to accomplish its missions without relying on CB weapons. This example does reflect how the government can see the political justification to start such a research and development program, but the program remains more of a political weapon than a military one. The cases of South Africa, Iraq, and Iran also demonstrate

the difficulties in stopping a nation from developing CB warfare programs. Although arms control treaties and watchdog organizations exist, and the major powers may pressure these countries to stop their offensive CB warfare programs, it is difficult to stop a country from developing a covert CB warfare program, especially if it does not rely on external sources for the chemicals and biological material to manufacture these weapons.

In 1987, it was reported that Libya used chemical weapons (obtained through Iran) against Chad, with less than successful results. For many years, the U.S. government was more worried about the offensive CB warfare program in Libya than in other countries in the Middle East, because of the country's oil wealth used to procure weapons and connections with terrorist groups. Libya constructed facilities for its chemical weapons program at two locations, Rabta and Sebha, and later, at a hardened underground facility at Tarhuna. This effort was believed to have been suspended in the 1990s, largely because the country lacks a scientific or technical base to advance past the laboratory stage. Its continued reliance on foreign sources for supplies allows the major powers to limit the precursors required for CB weapons. Libya once pursued the development of nuclear weapons and ballistic missiles, but this interest seems to have died off. In December 2003, Libya publicly announced its intention to abandon its unconventional weapons program and to open its facilities to the international community. Libya's change of heart came in part because of its desire to reengage the global economy and in part to allow its citizens to travel overseas for business and education reasons. Libya has signed the BWC and in January 2004, signed the CWC. Following Libya's acceptance of the CWC, OPCW inspectors verified the existence of 3,500 aerial bombs capable of using chemical agents, 50,700 pounds of mustard agent precursors, and 2.9 million pounds of nerve agent precursors. The U.S. government is currently working with the Libyan government to destroy these agents.

A number of other Middle Eastern and African countries remain on the suspect list. Ethiopia and Sudan are suspected of developing, or at least of being interested in developing, chemical weapons capabilities, programs that were thought to have been supported by Iraq. Both states have internal conflicts with rebels and guerrillas, fights their conventional forces have been unable to contain. Iraq's connections with Sudan led to the U.S. government's cruise missile attack on a suspected chemical weapons

production facility in August 1998. Saudi Arabia came under suspicion when it purchased 50 CSS-2 ballistic missiles from China. These missiles are inaccurate and of little value if used with conventional warheads, but if equipped with chemical warheads, they would do just fine on the battlefield (Hogendoorn 1997).

The Americas

Cuba is perhaps the only country in the Western Hemisphere that is still thought by the U.S. government to be interested in an offensive CB weapons program. Although Brazil and Argentina have had their conflicts and interests in nuclear weapons, there is no evidence that they have any interest in CB weapons, although they both have the technology and infrastructure to develop such weapons. During the height of the Cold War, Cuba no doubt benefited from education and funding from its Soviet colleagues in developing its military capabilities. Ken Alibek relates in his book that the Soviet Union had supported the development of biotechnology research in 1981, research that led to a very sophisticated genetics engineering laboratory that might be used for BW research. Although the U.S. government remains convinced that Cuba has an active BW program, it is actually Cuba that has accused the United States of BW attacks against its agricultural industries over the years (Alibek and Handelman 1999, 273–275). Whether Cuba has this capability or not, it is not known to have used CB weapons in any military operation. Cuba is a signatory of both the BWC and CWC.

Canada has a past role in offensive CB warfare research, one that is not as well known as the U.S. or U.K. efforts. Between 1937 and 1947, Canadian researchers supported both major powers in the development of anthrax as a weaponized agent. Open air and laboratory CB weapons tests were conducted at a military research station near Medicine Hat, Alberta. Canada had developed small stocks of mustard and nerve agents, which had all been destroyed by 1990. The overwhelming majority of Canada's research was in support of developing defensive measures. To that end, Canada joined with Britain and the United States in a tripartite agreement to share information and research on CB defense efforts (Bryden 1989). In the 1980s, Australia joined this research effort, creating the ABCA (American-British-Canadian-Australian) Quadripartite group.

The Non-State Actors

The final "threat" category addresses those groups and individuals who do not belong to any one nation—the non-state actors. This is a broad term meant to include criminal organizations, religious cults, militias unaffiliated with any legitimate governments, psychotics, and disgruntled employees attacking or threatening public citizens or the government—and terrorist groups. All these categories of people have been accused of or indicted for using "weapons of mass destruction" against the public. Entire books have been written about terrorism and the potential for terrorists to employ CB weapons or materials. I will not attempt to duplicate what has already been discussed in these sources, but there is a need to examine why politically motivated terrorists in particular might want to use CB warfare agents. Certainly it appears that most politicians and analysts seem most troubled by the possibility that terrorists might obtain or develop a "weapons of mass destruction" capability for use against the public. However, when terrorists employ small amounts of chemical or biological warfare agents to cause panic, it becomes clear that this capability cannot destroy structures or cause mass casualties. These weapons of mass *disruption* are very effective as fear-inspiring tools against the unprotected public.

Terrorist groups have been interested in CB warfare agents since at least the early 1970s, perhaps as they observed the mass media focus on CB warfare created as a result of multiple events (at the Rocky Mountain Arsenal in 2000, at Dugway Proving Ground in 1968, the use of Agent Orange and tear gas in Vietnam, the CHASE operation, the nerve agent leak at the Army depot in Okinawa, and so on). The goal of terrorists is to perpetrate violence against noncombatants to influence a broader audience (to paraphrase the U.S. State Department's definition). Certainly if a terrorist group were to use CB warfare agents against a civilian or military target, it would get into the national (and international) news. The technology to develop CB warfare material is not out of reach of a university-educated individual funded by a wealthy sponsor. If this is the case, why have we not seen more cases of CB terrorism?

In a review of historical cases, Dr. Jonathan Tucker of the Monterey Institute International Studies makes the point that in general, politically motivated terrorists have not sought to use or

threaten to use CB warfare agents for several reasons: their unfamiliarity with the required scientific technologies, the hazards and unpredictability of toxic agents, moral constraints, concerns that CB weapons use could alienate current or future financial sponsors, and concerns that CB weapons use could bring down a heavy retaliation from the affected government (Tucker 2000, 266). Terrorists can use conventional arms very simply and without much hazard; rifles, explosives, and knives work and the message still gets across. It is not that terrorists could not create a mass casualty event, given a large quantity of CB warfare agents and the right location and time. Rather, it is not necessarily in their interests to do so.

This observation does not mean that simply because large numbers of civilians do not get hurt by CB terrorism, the governments of the world do not have to prepare to respond to potential CB terrorism events. The threat exists, but the question is, how credible is the risk and how much should governments spend to prepare for it, as opposed to other public threats and hazards? There is a great deal of misinformation by so-called experts in the field, the result of which has been the over-quoted warning "It is not a matter of if, but when." Nearly twenty years have passed since the Rajneeshees poisoned a salad bar in Oregon, and since then, the anthrax-tainted letters seen in the United States in 2001 have been the only case of successful CB terrorism. Based on the 2001 anthrax incident, the government is spending billions of dollars to prepare every town and state to be ready for the next attack. This is in addition to the development of a large and expensive national BW vaccine stockpile, despite the difficulties the Department of Defense has had in executing an anthrax vaccine program. The history of CB terrorism tells another story.

Over the past thirty-five years, the actual use of CB warfare agents as a terrorist tool has been very infrequent and, in nearly all cases, did not come near to being classified as a mass casualty incident. In 1970, the Weather Underground allegedly thought about poisoning reservoirs with CB warfare agents from Fort Detrick, but nothing happened. Two years later, a cult called RISE planned to use BW against humanity to "start over" with the human race. The attacks never occurred. The Alphabet Bomber threatened to use sarin nerve agent in his attacks against the government in 1972 but never got around to producing it. The Baader-Meinhoff gang was alleged to have stolen mustard agent

containers from the German government in 1975, but later analysis suggests it was a hoax. Along similar lines, the Red Army Faction allegedly had a man cultivating botulinum toxin in the bathtub of a Paris safe house; again this was ruled a hoax. We've talked about the Rajneeshee cultists' use of salmonella in 1984 to stop election results from turning against them. In 1986, a militia group known as the Covenant, the Sword, and the Arm of the Lord stockpiled potassium cyanide to poison local wells but was caught prior to any incidents. Another anti-government group, the Minnesota Patriots Council, extracted small amounts of ricin from castor beans to create a tool with which to assassinate local officials in 1991. While some believe that the World Trade Center bombers deliberately placed cyanide in their truck bomb in 1993, most believe that the allegation is false. Aum Shinrikyo's attack in Tokyo is infamous, but prior to their use of sarin nerve agent in the subway, they had a string of unsuccessful BW attacks (Tucker 2000, 250–251).

The anthrax letters sent by a yet-unknown individual in October and November 2001 caused much panic but only eleven deaths. The FBI suspects that an American formerly associated with biological warfare research is the culprit, rather than a terrorist group. Al Qaeda has expressed interest in using unconventional weapons and has experimented with industrial chemical hazards as terrorist weapons, as evidenced by documents and materials found in Afghanistan by U.S. forces in 2002, but it has not used CB hazards in any terrorist attacks. In January 2003, British police arrested a suspected Algerian member of al Qaeda, discovering materials and equipment that might have been used to create quantities of ricin, cyanide, and botulinum toxin. In April 2003, the FBI arrested William Krar, a white supremacist in Texas, and Judith Bruey for hoarding a stockpile of military arms and ammunition, and, among other materials, 800 grams of sodium cyanide perhaps intended to become a chemical bomb. A disgruntled trucker known as "Fallen Angel" sent a letter containing a small amount of ricin to the White House in October 2003. In January 2005, the FBI raided the house of Steven Ekberg in Florida, where they found several assault rifles and handguns along with a box of glass vials holding chopped-up castor beans and a white powder that proved to be ricin.

One might see a pattern here: for the most part, domestic non-state actors tend to rely on easily accessible industrial chem-

icals or biological materials that might affect a small group of people or individuals within a confined area. There is no evidence that the American anthrax attacks were aimed at anyone other than the individuals to whom the letters were sent; the cross-contamination in the post offices was probably an unexpected side effect. Apocalyptic groups may be more likely to consider military CB warfare agents. The Aum Shinrikyo cult remains the only group that had the financing and the motivation to create or obtain a true military-grade CW agent, and also the only group to have created a true mass casualty event. This does not mean that a large-scale mass casualty terrorist event will never happen, but it does indicate that the politically motivated terrorist groups seem to rule out such events.

A far bigger problem than actual BW terrorism events has been the number of hoaxes that have occurred, from people phoning schools with "anthrax warnings" to people who put flour in an envelope to scare their office colleagues. The emergency response from state and federal agencies costs thousands of dollars each time, and there have been hundreds of hoaxes across the country as well as in other nations. These reactions are often based on the assumption that the responders need to be prepared to combat a worst-case scenario in case a potential threat is not a hoax—but after numerous false alarms and no actual events for years, one must reassess that assumption. The tough questions are these: How much will the response program cost to adequately protect everyone? Who will implement the program? Who is responsible for its oversight, and when is the public to know when the government has done enough? When does one decide that it's more important to spend that money on issues that affect people every year, such as natural disasters?

Terrorists will probably keep using conventional attacks because they work fine and get the required results. Ironically, some experts think that the recent awareness of terrorism and resulting security measures to harden buildings (including the Jersey barriers forcing cars and trucks to keep at a distance) may drive terrorists toward CB weapons. If terrorists do decide to use CB weapons, the amounts they will employ will be small amounts, enough to scare people and cause a huge response, but not enough to kill thousands. These CB terrorist attacks, if they come, will not occur outdoors where a small amount of agent will disperse quickly into the air. Rather, they will be used indoors where

the agent effects will linger, as happened in the Hart building and the Brentwood post office.

As to where terrorists will attack, they do not plan to attack targets with unconventional weapons that will be different from the targets for conventional weapons. As we have seen in Israel, they attack shopping malls, sports events stadiums, bus stations, coffee shops—anywhere people congregate in public. They are not going to hit the individual homes in the suburbs, although commercial and public buildings may be at risk during the business day. They use letter bombs, small aerosol cans, poisoned darts, rigged bags of agent that leak into a subway car—any form of improvised delivery device, aiming not at mass casualties but at mass disruption. When a CB terrorist event hits the news, of course a few people may have died, but thousands will think they were at risk because they were in the general vicinity of the event—what some experts are calling the “worried well.” These “worried well” are the real targets of mass disruption.

There has been increased concern that terrorists might attempt to damage or blow up a chemical production facility in an effort to release a large amount of industrial chemicals against the public. Because of the potential impact on the surrounding population, some have even called this a potential “WMD” incident. Although nuclear power plants have numerous redundant safety measures and heavy security, chemical facilities have not been so hardened. Part of the reason is that there has been no history of terrorists attacking chemical facilities, and that emergency responders and the chemical industry understand and can contain hazardous material incidents resulting from most accidents. Chemical production plants should have a certain level of security and safety in their practices, but the chemical industry is concerned that Congress might impose excessive record-keeping requirements and enforce unnecessary increases in security when there is no apparent threat. The question is, should there be mandated national standards imposed on every chemical production facility near a major city, or are there less stringent but equally effective methods to mitigate this low-probability, high-consequence event? It becomes a question of cost to the taxpayer versus balancing everyday risks.

People need to differentiate between battlefield employment of CB warfare agents and terrorist use of CB hazards; otherwise, one could make huge errors in judgment by overestimating the po-

tential impact of terrorist events and the need to address such events. Military forces invest in CB warfare because the large-scale use of such weapons gives the using military force a critical edge on the battlefield. Large-scale use of CB warfare agents against unprepared personnel creates mass casualty events, but military troops usually know if the adversary has such a capability, plan for its use, and understand that there is a high probability of such use occurring. On the other hand, terrorists may use small amounts of CB warfare agents not because of their military effectiveness but because they know the people, being ignorant about their effects, are terrified about them. However, the probability that terrorists will use military-grade agents, as opposed to improvised hazards or conventional weapons, is extremely remote; as history has shown, the threat of use is more often seen than any actual use of CB hazards. While the same CB defense equipment and operational concepts of use may translate from the battlefield to the city streets, the scale of the event, the people being attacked, and the probability of such events happening differ tremendously.

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4

Chronology

This chapter presents a time line of chemical and biological warfare throughout the world, focused primarily on the dawn the twentieth century to the present. There are certainly roots to CB warfare that predate the twentieth century, but such warfare was more the exception than the rule. Although science had supported the development of weapon systems in the past, it was the maturity of chemical sciences and engineering in mass production industries in the twentieth century that allowed CB warfare to become a true branch of the military arts. A review of this history will help set the stage for discussions on how nations have dealt with CB warfare events.

Early History (1000 BC?–1899)

Incidents of CB warfare are woven throughout many conflicts of history, from the Chinese to the Greeks to European military forces. Whenever there has been conflict, there have been those developing new ways to defeat their adversaries. For the most part, attempts to weaponize chemicals or biological organisms during this period were relatively crude and were not part of a sustained military effort to develop a true CB warfare capability. Instead, they are instances of military forces using their own intuition and improvisation to weaken or break the morale of the enemy, rather than the development of a new method of warfare. These methods included poisoning wells, using toxic smokes, and catapulting corpses into walled cities. It was not until the nineteenth century that chemistry began to come into its own as a true

science, replacing alchemy, leading people to theorize about what this branch of science could do to support military operations.

Birth of Modern Chemical Warfare (1915–1946)

Although many might credit Fritz Haber with being the father of modern chemical warfare, certainly the topic was under review by many nations prior to 1915. Both British and French scientists examined various chemicals for use as tear gases to irritate and demoralize opposing forces. The French use of tear gas projectiles in 1914 became a justification for the Germans to investigate chemical warfare options. The Germans were significantly more advanced in chemistry than their European cousins, partly because of a strong dye industry. Other German scientists had developed artillery projectiles with chemical fills in 1914, and these were employed against the British in October and the Russians in November, without any visible effects. It was Haber who suggested creating a toxic cloud using not artillery shells but a line of gas cylinders; this was more effective as a wide area weapon and helped reduce a dependency on high explosives for delivery. Haber's idea led to the first successful gas attack at Ypres in April 1915, when 168 tons of chlorine gas were used against unprepared Allied forces.

The use of chemical weapons quickly escalated on both sides, until almost half of all artillery shells were chemical-filled projectiles. Although the British and French decried such attacks as immoral and barbaric, they were quick to develop and use the same weapons throughout the rest of the war. Erich Maria Remarque's excellent novel *All Quiet on the Western Front* mentions the impact of British gas attacks against the Germans, for instance. After the war, European forces tried to implement treaties that would limit certain forms of warfare seen in the Great War, including chemical warfare. This led to the Geneva Protocol of 1925, which called for no first use of chemical weapons but did not ban the production and storage of gas weapons for purposes of retaliation in kind.

Military theorists envisioned a major role for strategic bombers loaded with gas weapons in the future of warfare, leading all nations to continue their research efforts into both offensive

and defensive chemical warfare. At the advent of World War II, this led to the mass manufacture of civilian gas masks in addition to military masks and suits, detectors, and decontaminants. The massive U.S. industrial complex quickly built up a military CB weapons infrastructure in anticipation of Axis use. For the reasons mentioned earlier in this book, these attacks never came. Following the war, the discovery of Germany's nerve agents ensured that the United States, its Western allies, and the Soviet Union would continue their research and development.

Cold War Era (1947–1990)

The development of biological weapons during World War II added a new aspect to chemical warfare, as these weapons also were an application of scientific products against human physiology. The U.S. Army's Chemical Corps also began to take part in nuclear weapons development; their focus was the study of radiological contamination on the grounds that the corps had the technical specialists when it came to scientific products of war. The Korean conflict brought fears that the Soviet Union and its allies were preparing to use CB weapons against U.S. forces, revitalizing the CB warfare infrastructure. With the two superpowers facing off against each other, the term *weapons of mass destruction* came into vogue, lumping the new nuclear weapons with their significantly less destructive cousins, chemical and biological weapons.

The Cold War era is the high point of the U.S. and Soviet Union's CB warfare programs. The era was marked by a massive research and development effort to turn the new nerve and biological agents into tactical weapons for the military. The two superpowers' offensive programs were remarkably similar, focusing on many of the same agents and delivery systems and on testing these systems to determine their large area coverage capabilities. For the first twenty years of the Cold War era (1947–1967), the development, testing, and evaluation of various CB warfare agents remained primarily in the domain of the two superpowers, who stockpiled the successful candidates in preparation for future conflicts. However, other nations were starting their investigations into developing this same capability.

By 1968, the military forces in both countries had a sophisticated and robust CB warfare capability. At first, rather than being

considered weapons of mass destruction, these agents were seen as a halfway step between conventional and nuclear conflict. But increasingly, arms control talks in the 1960s viewed these unconventional weapons as just as deadly as, if not worse than, nuclear weapons. Because the two superpowers were not going to give up their nuclear arms, arms control groups focused on reducing or eliminating CB weapons. Although the two superpowers participated in these multilateral talks, it was clear that neither one trusted the other. The key obstacle in these discussions was the point of verification, which required a nation to permit inspections of its facilities and stockpile sites to assure other nations that it was in compliance with the respective treaties.

Proliferation of CB Weapons (1968 to the Present)

Rather than discussing biological and chemical weapons together in arms control talks, it was easier to separate them, in part because no one had used biological weapons against any major power whereas several nations had either used or possessed stores of chemical weapons. This led to the development of the Biological Weapons Convention (BWC), which had no verification component (no one could agree to a common set of acceptable protocols). President Nixon's 1969 announcement that the United States was unilaterally disestablishing its offensive BW program was made in the good faith that other nations might follow suit. Instead, the Soviet Union, believing that the United States had simply moved its offensive BW program underground, redoubled its efforts. The United States decided to resume modernization of its CW stockpile in the late 1970s, partly out of concern that the Soviet Union had so enlarged its offensive program that U.S. military forces would be at a significant disadvantage in any conflict. This decision led to the resumption of the binary chemical weapons program, whose research had been halted in 1972.

Increasingly, other smaller nations began developing their own offensive CB warfare programs, often paralleling the Soviet and U.S. offensive program histories. With increases in education and industrial capability across the globe, any nation could develop the basic tools to research and develop a CB warfare capa-

bility. There was international trade in bulk chemicals, and industrial nations built facilities overseas and sold dual-use (military or commercial) equipment to smaller nations that were willing to buy their services; therefore, these nations could produce their own stockpiles of chemical weapons. With continued conflicts across the globe, nations had the incentive to build a CB warfare program before their adversaries did. The basic template remained the same; first they developed and tested chemical weapons, then they would develop and test biological weapons. Although only a few conflicts have seen the use of CB weapons, the potential for future CB warfare conflicts continues while these countries retain their CB weapons stockpiles.

The advent of new technologies, such as ballistic missiles, cruise missiles, and unmanned aerial vehicles (UAVs), has increased the ability of many nations to develop and deploy their CB warfare capabilities against major forces without significantly imperiling their own forces. These delivery systems could use either conventional high explosives or CB warfare agent payloads. Many countries today do not aspire to become superpowers holding 30,000–40,000 tons of stockpiled munitions. A smaller stockpile of a few hundred or a few thousand tons of CW agents will do fine, if managed and delivered to the right place on the battlefield at the right time. These facts make it difficult to monitor and inspect suspect nations for violations of arms control treaties

The ability of non-state actors (whether terrorist groups, freedom fighters, irregular militias, death squads, or others) to develop rudimentary CB warfare skills has become increasingly greater. If terrorist groups have the resolve to move from conventional weapons to unconventional ones, they can buy specialists and the required equipment. Many groups can get away with bluffs and hoaxes, or they can experiment with small portions of homegrown toxins to threaten particular targets. At the same time, the motivation and desire of non-state actors to use CB hazards to frighten or harm civilians has to be considered—to date, while the equipment and technical knowledge has increased, actual terrorist attempts to use military CB warfare agents (in particular) to cause mass casualties have not taken place. Aum Shinrikyo's use of sarin in Tokyo has been seen as more of an aberration than an indication of the future, yet it has frightened enough politicians to make them start thinking seriously about the potential of future terrorist attacks.

CB Warfare Time Line

- 1000 BC** Chinese armies use arsenic smokes in battle.
- 600 BC** Assyrians contaminate enemy water supplies with rye ergot. This fungus produces a hallucinogen similar to LSD.
- 429–** Spartans and their allies use toxic smoke (from burning wax and sulfur) and flame (pitch) against Athenian-
- 424 BC** allied cities during the Peloponnesian War.
- 800–** Besieging armies in Europe and Asia catapult diseased corpses over city walls to weaken the defenders and force an early capitulation. European scholars develop alchemy, brought by Arabs to Spain.
- 1300**
- 1347–** Twenty-five million people in Europe, nearly one-third of the population, die from bubonic plague. The disease is suspected to have come from trade ships traveling from China to Italy.
- 1352**
- 1675** The Treaty at Strassburg between the French and Germans outlaws the use of poisoned bullets. This is the first international agreement prohibiting poisoned weapons.
- 1763** British soldiers give smallpox-infected blankets to Indians at Fort Pitt, Pennsylvania. This disease wipes out a large Indian population on the East Coast.
- 1855** During the Crimean War, Sir Lyon Playfair proposes to the British High Command that the military should use cacodyl cyanide-filled projectiles to break the Russian forces. The British military reject the idea.
- 1863–** Union forces examine proposals to fill artillery shells with chlorine liquid and to mix hydrochloric and sulfuric acid to create a toxic cloud. Instead, the Union issues General Order No. 100, which states "The use of poison in any manner, be it to poison wells, or food, or arms, is wholly excluded from modern warfare." Confederate
- 1865**

forces, on the defensive, poison wells and ponds to deny water sources to the advancing Union forces.

- 1874 The "International Declaration concerning the Laws and Customs of War" is adopted in August at the Conference of Brussels includes provisions prohibiting the use of poison or poisoned weapons. It is not ratified by the fourteen European nations, but its language returns at The Hague conferences.
- 1887 British, French, and German governments begin considering the use of tear gases for military purposes.
- 1899 The First Hague Convention with Respect to the Laws and Customs of War on Land is signed on July 29 forbidding "the use of projectiles the sole object of which is the diffusion of asphyxiating or deleterious gases." Twenty-seven nations sign, including France, Germany, Italy, Japan, Russia, and Great Britain. The United States does not sign the treaty.
- 1907 At the Second Hague Convention, the Declaration Concerning Asphyxiating Gases is signed on July 29, codifying the language of the First Hague Convention.
- 1914 Garrett Morgan, a black U.S. businessman in Ohio, obtains patent rights for a breathing device in October. He created the "safety helmet" for firefighters. While not the first gas mask to be patented, his design becomes a basis for the U.S. Army's gas mask model in 1917.
- 1915–1916 The Germans successfully use 168 tons of chlorine against the Allied forces at Ypres on April 22 and use the gas five more times in April and May. The British retaliate at Loos on September 15 with 150 tons of chlorine, albeit less successfully. The Germans escalate to using phosgene at Ypres by the end of the year, with the British using phosgene against the Germans at Somme in June 1916.
- 1916 The Germans begin to use diphosgene in May. The French try hydrogen cyanide in July and cyanogen chloride in the

- 1916** fall. Both sides begin to mix agents and experiment with camouflage materials to prevent quick identification.

cont.
- 1917** The Germans introduce mustard agent at Ypres on July 12. The British use mustard agent against the Germans in September 1918, but they rely more on phosgene as their main weapon. The U.S. Army establishes a Gas Service in the American Expeditionary Force, with its main laboratory at Edgewood Arsenal, Maryland. By the end of the war, it is estimated that more than 124,000 tons of chemicals are employed by all the belligerent forces.
- 1918** On June 28, the War Department formally establishes, by executive order, the Army's Chemical Warfare Service, which is to assume full responsibility for all facilities and functions relating to toxic chemicals as of July 1, 1918.
- 1919** The Treaty of Versailles, signed on June 28, prohibits Germany from producing, importing, or using "asphyxiating, poisonous or other gases and all analogous liquids, materials, or devices."
- 1920** The U.S. Army decides to disestablish its Chemical Warfare Service and to move the responsibility for defense and retaliatory measures to the Corps of Engineers. Instead, Congress authorizes the permanent establishment of the U.S. Army Chemical Warfare Service on July 1.
- 1922** At the Washington Arms Conference, the U.S. delegation suggests language abolishing chemical warfare. Although the arms control treaty is ratified by the United States and other countries, it is not enacted because of French objections to language concerning the use of submarines in combat.
- 1925** The Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare is signed on June 17. The protocol condemns the use of CB weapons except in response to first use by a belligerent state using CB weapons. The United States signs the protocol, as do twenty-eight other countries, but the Senate rejects the treaty.

- 1935– Italian forces in Ethiopia use mustard bombs and aerosol
1936 sprayers against Abyssinian guerrillas to protect their flanks and to attack the enemy rear areas. Ethiopia appeals to the League of Nations, which imposes limited economic sanctions against Italy in an effort to stop the war.
- 1936– German scientists discover tabun and sarin, later type-
1938 classified as nerve agents GA and GB. Germany does not use these CW agents in its attacks against France or the Soviet Union, but the German government builds a few weapons factories to develop a retaliatory capability in the event that Allies use chemical weapons against Germany.
- 1937– Japanese forces in China begin to use CB weapons and
1942 tear gas grenades against poorly equipped and trained Chinese forces. China appeals to the League of Nations but receives no response.
- 1940– The United States produces more than 146,000 tons of
1945 CW agents as a potential retaliatory capability against the Germans and Japanese. The United States also produces thousands of portable laboratories; hundreds of thousands of chemical protective masks for soldiers and civilians, detector kits, and impregnated uniforms; and millions of gallons of decontaminants.
- 1941– Secretary of War Henry Stimson asks the National Acad-
1945 emy of Sciences to appoint a Biological Warfare Committee in 1941. In February 1942, this committee recommends that the United States take steps to reduce its vulnerability to biological warfare, resulting in the creation of the War Research Service in August 1942. In April 1943, Camp Detrick, Maryland, is activated as the center for BW research.
- 1942 The British test weaponized anthrax on Gruinard Island, off the northwest coast of Scotland. The island is sealed off for nearly fifty years until it can be decontaminated to a level permitting unprotected civilians to come back.

1943 In December, a German air raid against the port of Bari in Italy damages the SS *John Harvey*, a U.S. ship carrying more than 100 tons of mustard-filled aerial bombs. This results in a large release of mustard agent into the port's waters, causing more than 600 military and civilian casualties. The harbor cleanup takes three weeks.

1944 German scientists discover soman, later type-classified as nerve agent GD. Soman is much more persistent and lethal than the earlier nerve agents.

The United States builds a large-scale anthrax production plant at Vigo, Indiana, near Terre Haute. The military runs tests with biological simulants to ensure it can be safely operated. In the meanwhile, Camp Detrick produces weapons-grade anthrax at its pilot plant. An initial batch of 5,000 four-pound bombs are produced and sent to Britain.

1945 The U.S. Army develops plans to move chemical munitions to the Pacific in anticipation of a forced ground invasion of the Japanese islands. With the use of nuclear weapons against Hiroshima and Nagasaki, these plans are scrapped.

1946 The Army demobilizes the Chemical Warfare Service, which had grown from 2,000 specialists in 1940 to nearly 70,000 at the peak of World War II. Congress authorizes the formation of the Chemical Corps on August 2.

1947 Pfizer, Inc., purchases the Army's anthrax production plant at Vigo and converts it into a plant producing veterinary-grade antibiotics. The Vigo plant had never been used to produce anthrax, its intended role, during the war.

1948 The U.S. military standardizes G-nerve agents tabun and sarin for their arsenal and begins to develop new detectors and protective ensembles for the new agents. The M-9 protective mask is the first one of its kind to protect against both chemical and biological warfare agents.

- 1948–1955 The United Kingdom executes five major open air CB weapons trials, all carried out at sea. The intent is to determine the potential operational impact of these weapons on the battlefield, specifically how much area can be covered with specific weapon systems.

- 1950 The U.S. Navy sprays San Francisco, from a ship two miles off-shore, with *Serratia marcescens* (simulating tularemia) and *Bacillus subtilis* (simulating anthrax) to test the potential coverage of a covert BW attack against a major city.

- 1950–1953 The United States builds facilities at Muscle Shoals, Alabama, and Rocky Mountain Arsenal, Colorado, to produce GB nerve agent. The building of a biological weapons production plant is initiated at Pine Bluff Arsenal, Arkansas, in 1951.

- 1952 The Army Chemical School moves from Edgewood Arsenal in Maryland to Fort McClellan, Alabama.

- 1952–1953 British scientists discover nerve agent VX, an agent more persistent and toxic than the G-series agents, and share this information with the United States.

- 1954–1973 The U.S. Army exposes Seventh-day Adventist volunteers to Q fever at Dugway Proving Ground. This is the beginning of Operation Whitecoat. All volunteers recover fully.

- 1954 As Italy and Germany join the Western European Union in October, they declare that they will not manufacture any chemical or biological weapons in their territories.

- 1956 Camp Detrick becomes Fort Detrick in February.

- Marshal Georgy Zhukov, the Soviet defense minister, tells the Twentieth Party Congress that future war will feature “various means of mass destruction, such as atomic, thermonuclear, chemical and bacteriological weapons.”

- 1956** U.S. military policy changes to require the military to be prepared to use CB warfare agents in a general war to "enhance military effectiveness." The decision to use CB warfare agents is still reserved for the president.

cont.
- 1957** The United States standardizes VX nerve agent for weaponization and in 1959 builds a plant at Newport, Indiana, to produce the nerve agent. The Soviet Union develops a variant of VX for their own military purposes.
- 1959** The United States moves chemical weapons to West Germany to be stored in Army bunkers as a retaliatory capability against potential Soviet chemical attacks.
- 1960** International negotiations begin in Geneva to ban chemical weapons and to require the destruction of all chemical munition stockpiles.
- 1962** In response to requests from the South Vietnamese government, the U.S. government authorizes Operation Ranch Hand for anti-crop operations (attacking Vietcong rice fields). This operation grows to support major defoliation operations across the country in an effort to eliminate ambush sites around bases and along rivers. The main agents used are Agents Orange and Blue.

The Army establishes Deseret Test Center at Fort Douglas, Utah, next to Dugway Proving Ground. Under the name Project 112, the center supports open-air CB weapons testing for all the military services developing new delivery systems.
- 1963–** The U.S. Navy runs Operation Ship Hazard and Defense
1969 (SHAD), part of Project 112, to evaluate CB weapons and defensive equipment. Both simulants and CB warfare agents are used without incident.
- 1965** U.S. advisors to South Vietnamese troops use tear gas grenades in Vietnam for self-protection. Use of tear gas grenades and CS powder, a riot control agent, increases as more U.S. troops deploy. Critics accuse the United States of gas warfare in Vietnam.

- 1965–1966 The military uses BW simulants to test the potential spread of terrorist-employed BW agents at the National Airport, at the Greyhound Terminal, in the Pentagon's air-handling system in Washington, D.C., and in the New York subways.
- 1967 Egyptian forces bomb Yemeni royalists with mustard and nerve agents, causing over a thousand casualties during the Yemeni civil war. Soviet support is suspected.
- 1967–1969 Operation CHASE (Cut Holes and Sink Em), a program to dispose of conventional munitions at sea, accepts shipments of obsolete chemical munitions. Environmental and political concerns stop the ocean dumping, although no signs of any contamination or damage to the environment are noted from the dumps, which take place 250 miles from the U.S. shores.
- 1968 In March, local ranchers accuse Army testers at Dugway Proving Ground of injuring more than 6,000 sheep. The Army makes a financial settlement with the ranchers without admitting guilt. Congress calls for hearings that eventually result in the end of open-air CB weapons tests in the United States.
- 1969 On July 2, the United Nations releases a report from an international panel of scientists studying the danger of CB warfare, calling for the elimination of CB weapons stockpiles worldwide. They conclude that there is no defense against CB weapons and no predicting the duration of effects on the environment.

On July 8, twenty-three U.S. soldiers are exposed to low levels of sarin while repainting depot buildings on Okinawa but are back on duty in twenty-four hours. The resulting media blitz ten days later reveals to the public the presence of U.S. chemical stocks overseas. By the end of the month, congressional representatives leak information to the press that there are CW stocks in West Germany as well.

1969 In July, the United Kingdom submits a draft convention to the national delegates at Geneva for the prohibition of the development, production, and stockpiling of biological and biological toxin weapons. In September, the Soviet Union submits a similar draft. These drafts become the framework for the Biological Weapons Convention.

cont. President Richard Nixon renounces the offensive biological weapons program and reaffirms the United States policy of "no first use" of chemical weapons on November 25. In February 1970, he extends the ban to biological toxins.

1970 In April, DoD orders a temporary ban on the use of Agent Orange, in part due to the increasing political criticisms about potential impact on the Vietnamese people and on the country's environment. In October, Congress calls for a National Academy of Sciences study on the ecological and physiological effects of the defoliation program conducted in Vietnam.

1971–1973 The U.S. military moves its chemical weapons from Okinawa to Johnston Island under Operation Red Hat. It destroys its stockpile of BW materials, changing the BW program to a biological defense research effort. The Soviets redouble their BW research efforts, suspecting the United States of continuing its work in secret.

1972 The Biological Weapons Convention is signed in Washington, London, and Moscow on April 10. Ratification by the Senate is delayed by its consideration of the Geneva Protocol of 1925 and by the question of whether herbicides and riot control agents are to be considered as CW agents.

The Army appoints Colonel Sam Bass as the Program Manager for Demilitarization of Chemical Materiel on October 11. His job includes disposal of aging and leaking munitions. In 1975, the post's title is changed to Program Manager for Chemical Demilitarization and Installation Remediation. The first project is the cleanup of Rocky Mountain Arsenal in Colorado.

- 1973** General Creighton Abrams, chief of staff of the Army, announces the disestablishment of the Chemical Corps in January, with the intention of absorbing its personnel into the Ordnance Corps as "special weapons" handlers. The Chemical School closes at Fort McClellan and moves to Aberdeen Proving Ground, Maryland.
- 1973–1975** Israeli and U.S. military analysts inspect Soviet armored vehicles with collective protection systems and Soviet detection and decontamination equipment captured during the Arab-Israeli Yom Kippur War. They are concerned that the Soviet military is planning to operate in CB warfare conditions in Europe.
- 1975** The Senate ratifies the Geneva Protocol of 1925 and Biological Weapons Convention on December 16, 1974. This allows President Gerald Ford to sign documents of ratification on January 22, subject to the provision that the United States can still retaliate with chemical weapons in response to an enemy's first use of chemical weapons. The convention enters into force on March 26, 1975.
- 1976** Secretary of the Army Martin Hoffman reverses the decision to disestablish the Army Chemical Corps, allowing the recruitment of chemical specialists for the first time in four years. The Chemical School reopens at Fort McClellan in 1979.
- 1978** In September, Bulgarian dissident Georgi Markov is assassinated in London with a pellet loaded with ricin and delivered by a spring-loaded umbrella. The use of ricin is not noted until a second assassination attempt on another Bulgarian dissident fails and the pellet is found.
- 1979** An unintentional release of airborne anthrax from the Soviet Institute of Microbiology and Virology at Sverdlovsk kills more than 100 civilians in the town. The Soviets blame gastrointestinal anthrax due to spoiled meat. In 1992, President Yeltsin admits it was an accident from a weapons production plant.

- 1980 The Conference on Disarmament's Ad Hoc Committee on Chemical Weapons continues negotiations on developing a Chemical Weapons Convention. More than forty nations participate, but the focus is on the two superpowers, without whom an agreement is worthless. There are three major camps: the NATO allies, the Warsaw Pact, and the non-aligned states.

- 1981 In September, Secretary of State Alexander Haig accuses the Soviets of supporting CB warfare in Laos in the mid-to late-1970s. This brings the issue of "yellow rain" to the public.

- 1983–
1988 Iraqi forces uses chemical weapons against Iranian forces during the Iran-Iraq War. Although Iran attempts to retaliate, it lacks the requisite technologies and training. Iran sues for peace after Iraq launches numerous Scud missiles against Iranian cities.

- 1984 In August and September, members of the Rajneeshee cult cause 751 residents of The Dalles, Oregon, to become sick due to salmonella sprayed on salad bars in local restaurants. Their intent was to shape upcoming elections in their favor.

The Australia Group, an international arms control group, is formed in response to Iraq's use of chemical weapons against Iran. Its goal is to recommend export controls on precursors and equipment that could be used to develop CW munitions.

The National Research Council endorses the Army's use of incineration as the best available technology for disposal of chemical munitions and materiel.

- 1985 Congress authorizes the U.S. Army to begin a national chemical disposal program to eliminate its aging stocks of unitary chemical weapons and to begin production of binary chemical weapons to modernize the U.S. retaliatory capability. These efforts are initiated under the Program Executive Office for Chemical Munitions, which

oversees the Program Manager for Chemical Demilitarization and the Program Manager for Binary Munitions.

Iraq begins its offensive BW program. It had been working on a CW program since the mid-1970s. Although Iraq uses chemical weapons against Iran, it never develops a capability for biological warfare prior to the end of hostilities.

- 1987 The United States accuses Libya of using chemical weapons against Chad in August and ships 2,000 protective masks to Chad.

The Soviet Union officially announces its possession of a CW stockpile. While U.S. estimates place the stockpile at 150,000 tons of chemical agents, later declarations put the number at 40,000 tons.

- 1988 Congress authorizes the Army to begin a Chemical Stockpile Emergency Preparedness Program (CSEPP) to improve emergency response at its eight chemical stockpiles and the surrounding communities.

- 1988–1990 The U.S. government asks the West German government to explain why West German companies had assisted Libya in the production and equipping of a chemical weapons facility at Rabta. In 1990, the U.S. government calls for the Libyan government to destroy the facility. In March 1990, a fire erupts in the complex, destroying much of the facility and its materiel.

- 1989 The United States and the Soviet Union sign the Wyoming Memorandum of Understanding, agreeing to exchange information on each other's chemical weapons stockpiles with the aim of leading to arms control talks. A year later, the two countries sign a Bilateral Destruction Agreement that commits them to reducing their respective CW stockpiles to 5,000 tons.

After two years of construction, the Johnston Atoll Chemical Agent Disposal System (JACADS) is ready for operation. Congress demands a vigorous operational

1989 verification testing prior to beginning full-scale operations.
cont.

1990 After certifying that there was no undue risk from anthrax, the U.K. Ministry of Defense returns Gruinard Island to the heirs of the previous owner. The island had been a testing ground for anthrax bombs in 1943.

In June, the Army begins full-scale tests at its disposal facility on Johnston Island. The military moves all chemical weapons stored in Europe to Johnston Island between September and the end of November under Operation Steel Box.

1990–1991 Iraq invades Kuwait in August 1990. The United States leads a coalition to force Iraq out of Kuwait. Fearing that Iraq might use CB weapons, the coalition uses diplomacy and threats of retaliation and prepares to counter this threat with increased training and with CB defense equipment. The conflict ends without any offensive use of CB weapons. One soldier is treated for mustard burns received while inspecting an empty Iraqi ammunition bunker.

1991 In March, engineers from the 82d Airborne Division demolish Iraqi munitions at Khamisiyah Depot. UNSCOM inspectors examine the remains in October and suggest that one of the thirty-eight bunkers blown up had contained chemical weapons. They also find several hundred mostly intact 122 mm rockets in a nearby pit and 6,000 intact 155 mm artillery shells filled with mustard agent.

The Army transports World War II mustard-filled artillery projectiles from the Solomon Islands to Johnston Island for storage and eventual destruction.

1992 The U.S. government reveals that the total amount of chemical weapons in its stockpile is 31,400 agent tons. The Russian government declares approximately 40,000 agent tons in its stockpile and states that it has ended the former Soviet Union's offensive BW program. Former

Russian scientists claim that Russia is still researching and developing new nerve agents more toxic than traditional G- or V-series agents.

The FBI arrests two members of the Patriots Council in Minnesota for possession of ricin under the 1989 Biological Weapons Anti-Terrorism Act.

- 1993** The Chemical Weapons Convention (CWC) is signed in Paris on January 13. The parties agree not to develop, produce, acquire, stockpile, or use chemical weapons; not to assist others to develop chemical weapons; and to destroy all existing stocks. The convention enters into effect on April 29, 1997—180 days after the sixty-fifth nation ratifies the treaty.

The U.S. Army starts the Non-stockpile Chemical Materials Project under the Program Manager for Chemical Demilitarization. One of its first projects is to assist in the cleanup of Spring Valley in Washington, DC, where chemical munitions were discovered in January, unearthed during construction of a housing project.

In August, the U.S. Army's second disposal plant completes construction at Tooele Army Depot, Utah. As it begins a three-year testing phase, the Army certifies that the Johnston Island disposal facility is safe and ready to assume full-scale operations.

U.S. intelligence sources note the construction of a deeply buried facility at Tarhunah, about sixty-four kilometers southeast of Tripoli, Libya. Several western European companies are suspected of being involved in the construction there of a CW production facility.

- 1994** The Aum Shinrikyo cult attacks the living quarters of three judges in Masumoto, Japan, with a truck-mounted generator issuing a sarin aerosol cloud, killing seven and injuring several hundred. No one is arrested.

Congress passes a public law (P.L. 103-160) forcing the military services to consolidate their four separate CB defense

1994 research and development programs into one defense-wide program, with oversight from one single focal point under the assistant to the secretary of defense for Nuclear and Chemical and Biological Programs (ATSD[NCB]).
cont.

1995 In February, Larry Wayne Harris is arrested for ordering a strain of plague bacteria through the mail from American Type Culture Collection. At his trial, he claims the purchase was for "defensive research."

The Aum Shinrikyo cult plants eleven bags of sarin on three subway lines on March 20. Twelve civilians die, more than 900 are hospitalized with symptoms of nerve agent poisoning, and four thousand "worried well" flood the hospitals believing they have been exposed while on the subway.

President Clinton issues Presidential Decision Directive (PDD) 39 "U.S. Policy on Counterterrorism" in June, which establishes the FBI as the agency in charge of crisis management and FEMA as in charge of consequence management. In 1997, a terrorism annex is added to the Federal Response Plan, which specifically addresses the federal response to a CB terrorist event in the context of crisis and consequence management.

In July, the Iraqi government admits that it had an offensive BW program, whose scale is confirmed after the discovery of Iraqi research documents and the defection of Saddam Hussein's son-in-law Hussein Kamal al-Majid. In February 1996, Hussein Kamal returns to Iraq, where he is assassinated.

1996 The Defense Department releases a statement that approximately 20,000 service members may have been exposed to low levels of nerve agents as a result of the Khamisiyah incident. This number is eventually raised to match conservative estimates of approximately 100,000 service members who may have been exposed.

Tooele Chemical Agent Disposal Facility (TOCDF) begins

disposal operations. Deseret Chemical Depot, located at Tooele Army Depot, holds 46 percent of the Army's chemical weapons stocks.

- 1997** The Senate ratifies the Chemical Weapons Convention on April 24. The CWC enters into force five days later. The Russian Federation ratifies the CWC in November. The Organization for the Prohibition of Chemical Weapons (OPCW) comes into being to enforce the treaty.

Unknown persons mail a petri dish filled with a red gelatin marked "anthrax" to the B'nai B'rith in Washington, DC, forcing more than 100 people to remain in quarantine while emergency responders work to contain the hazard. The event was later proven to have been a hoax.

In June, India acknowledges it has an offensive chemical weapons program and states that it will dispose of its chemical munitions under the CWC's auspices. South Korea also admits to owning a chemical weapons stockpile and one chemical weapons production facility, and promises to dispose of the munitions.

In response to congressional direction, the Defense Department initiates a program intended to train the emergency responders of 120 cities on the basics of responding to terrorist CB incidents. Trainers start with Denver, where the G-8 summit is to meet and where the Timothy McVeigh trial is to be held that summer.

- 1998** In February, federal agents arrest Larry Wayne Harris on the suspicion that he has weapons-grade anthrax in his car. It turns out to be an anthrax vaccine sample with only dead organisms.

U.S.-launched cruise missiles destroy a suspected nerve agent production plant in Sudan. Although the Sudanese government claims the plant was a pharmaceutical factory, the U.S. government is concerned that the factory was funded by Osama bin Laden for the purposes of developing CW agents.

- 1998** The Defense Threat Reduction Agency is formed from a consolidation of defense arms control and counterproliferation agencies and offices. The core of the reorganization is the Defense Special Weapons Agency, formerly the Defense Nuclear Agency.

cont.

The Department of Defense decides to vaccinate the entire military force against anthrax using a vaccine approved by the FDA in 1970. In 1999, the decision is made to extend vaccination to emergency-essential civilians and contractors operating in high-threat areas.

President Clinton issues PDD-62, "Combating Terrorism" in May, which creates a national coordinator for security, infrastructure protection, and counterterrorism. The document reaffirms PDD-39 and is similarly focused on terrorists using WMDs against U.S. citizens.

In June, CNN releases a news story accusing the U.S. military of using nerve agents in Vietnam under the name "Operation Tailwind." The story is later discredited by nearly all personnel involved in that operation and by the absence of any credible evidence.

In October, a wave of letters claiming to contain anthrax are sent to Planned Parenthood Centers and abortion clinics in Kentucky, Indiana, Ohio, and other states. The letters are revealed to have been a hoax.

In an interview, Osama bin Laden endorses the use of nuclear weapons as terrorist devices, saying "To seek to possess the weapons that could counter those of the infidel is a religious duty. . . . It would be a sin for Muslims not to try to possess the weapons that would prevent the infidels from inflicting harm on Muslims."

- 1999** In February, a second wave of letters claiming to contain anthrax are sent to Planned Parenthood Centers and abortion clinics across the country. Again the letters are revealed to have been a hoax.

In April, President Bill Clinton announces that the United States will not destroy its remaining stocks of smallpox, despite the World Health Organization's recommendation.

In September, the Army's Chemical School moves from Fort McClellan to Fort Leonard Wood, Missouri.

- 2000 The Johnston Atoll Chemical Agent Disposal System (JACADS) begins closure operations in November, after destroying more than 4 million pounds of chemical agents and more than 400,000 munitions.

In October, Army civilian workers discover six M139 bomblets suspected of holding sarin in a scrap yard at Rocky Mountain Arsenal. After the local citizens express concern about the Army's plan to blow up the munitions, the Army develops an elaborate explosive destruction system to destroy the munitions within a contained facility.

- 2001 In May, four more sarin bomblets are found at Rocky Mountain Arsenal. The Army's system destroys all ten without risk of exposure to anyone.

In June, the DHHS Advisory Committee on Immunization Practices recommends that emergency response workers be vaccinated against smallpox to prepare for and respond to a possible bioterrorism attack involving smallpox. While the Bush administration hopes that 400,000 volunteers will take the vaccine, less than 10 percent do.

The Bush administration formally announces its intent to reject the draft verification protocols for the BWC in July, prior to the fifth BWC Review Conference scheduled for November.

In October, four letters containing anthrax are delivered, two to Democratic leaders in the Senate, one to the American Media Inc., Boca Raton, Florida, and one to

- 2001** Tom Brokaw at New York's NBC Studios. FBI officials suspect that the sender is an American with biotechnology experience, perhaps gained at a military lab. Five victims die, six are treated for inhalation anthrax and recover, eleven are treated for cutaneous anthrax, and scores of postal workers and congressional staffers begin medical treatments.

After the events of September 11, Congress asks the Army if it can accelerate its chemical weapons disposal efforts, fearing that terrorists might attack the stockpiles. The Army proposes "Operation Speedy Neut," which plans to accelerate neutralization efforts at the two disposal facilities at Newport, Indiana, and Aberdeen Proving Ground, Maryland. Because of delays in funding and construction of the facilities, the effort is not "speedy" but takes several years.

- 2002** In January, the Senate Hart building in Washington, DC, is declared clean of anthrax spores. In October, the cost of cleaning the building and preparing it for occupation again is announced to be more than \$41 million. The Brentwood postal facility and the American Media building continue to be cleaned.

Construction of the Aberdeen Chemical Agent Disposal Facility is completed. Aberdeen's facility will be the first one to use an "alternative technology," that is, a technology other than incineration, to dispose of more than 1,600 tons of mustard agent. The selected technology is neutralization with hot water, followed by treatment at a chemical waste facility. Operations start in April 2003.

At the G-8 Summit in June, members announced the "G-8 Global Partnership against the Spread of Weapons and Materials of Mass Destruction." The United States pledges \$10 billion toward this effort and urges other G-8 states to donate to the cause of enhancing threat reduction efforts under way in the former Soviet Union.

In September, President George W. Bush accuses Iraq of maintaining an active CB warfare program before the

UN General Assembly. Prime Minister Tony Blair of Britain, in a statement to the House of Commons, repeats this charge and offers a dossier of intelligence data on Iraq's CB warfare program.

In late September, the Department of Health and Human Services releases an updated post-event "Smallpox Response Plan and Guidelines," which discusses the use of "ring vaccination" around smallpox outbreaks caused by terrorists.

The Russian military uses a chemical compound to knock out fifty Chechen terrorists holding several hundred people hostage in Moscow in November. More than 100 hostages die from the gas. The United States and other nations refrain from criticizing the Russian use of gas as an internal police action.

The Bush administration releases a *National Strategy to Combat Weapons of Mass Destruction* in December. This document discusses how the administration plans to combat the potential use of these weapons that could be in the hands of adversarial nations and terrorist groups.

2003 In January, British police arrest six Arab men in London, one of whom is associated with al Qaeda. In the apartment where the men resided, authorities found several castor oil beans and equipment that could be used to process the beans to make ricin toxin.

In February, traces of ricin are found in Senate buildings. It is suspected that the ricin may have been released as envelopes were shredded.

The U.S. and U.K. militaries, with multinational support, invade Iraq in late March with the stated mission of removing the threat of weapons of mass destruction. Despite concerns of Iraqi use of CB weapons, especially in a regime-survival situation, no CB weapons are used.

In April, the undersecretary of defense for acquisition, technology, and logistics (USD[AT&L]) signs a memo-

2003 *cont.* random announcing a new management structure for the DoD CB Defense Program. This includes a joint requirements office within the Joint Staff, a joint program executive office under the Army, and the Defense Threat Reduction Agency as the science and technology coordinator.

The Anniston chemical disposal facility starts its operations in August. It is the second disposal facility to use incineration as a disposal technology. More than 4.5 million pounds of chemical agent are stored at the Anniston Army Depot.

Yugoslavia destroys all its declared chemical materials and production capability under the supervision of CWC inspectors in September.

Moammar Gadhafi of Libya announces that his country will dismantle its weapons of mass destruction program in December. This announcement, following several years of negotiations with the U.S. and U.K. governments, leads the way for open international inspections to verify what Libya has and what will be needed to destroy its weapons and materials.

2004 In January, David Kay, the leader of the Iraq Survey Group, tells the Senate that "It turns out we were all wrong [in reference to Iraq's CB weapons program], and that is most disturbing."

In February, President Bush directs the formation of a Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, also known as the Silberman-Robb WMD Commission. This group is to look into the intelligence community's assessment of Iraq's WMD program.

DHHS announces the formation of a National Science Advisory Board for Biosecurity in March. Its purpose is to watch for the potential misuse of biotechnology research for offensive military or terrorist purposes.

At a joint DoD-DHHS-DHS press briefing in late April, Bush administration officials release "Biodefense for the 21st Century." The document outlines several national biodefense efforts, to include BioWatch, BioShield, and other measures.

The Army's chemical disposal facility at Umatilla, Oregon, starts operations in September. Plans are to run disposal operations for three years.

The CIA releases the findings of the Iraq Survey Group in October. The three-volume report, running nearly 1,000 pages, suggests that although no modern CB weapons were recovered, Saddam never abandoned his intentions to resume CB weapons programs. The team returns to the United States in December.

A federal judge in Washington, DC, halts the DoD anthrax vaccination program in October out of concerns that the FDA did not properly validate its safety and efficacy. In December, DoD requests DHHS declare an emergency order to justify continued use of the vaccine on a volunteer basis. This declaration is given in January 2005.

- 2005** In January Defense Secretary Donald Rumsfeld assigns the U.S. Strategic Command the responsibility to "integrate and synchronize" the Defense Department's efforts to combat weapons of mass destruction.

Director of Central Intelligence Porter Goss tells the U.S. Senate in February that "it may be only a matter of time before al Qaeda or another group attempts to use [CBRN] weapons."

The President's WMD Commission delivers its final report at the end of March, concluding that the intelligence community was "dead wrong in almost all of its pre-war judgements" about Iraq's WMD program. It finds no indications that the evidence (or lack thereof) of Iraq's WMD program was distorted.

2005 In March, the Pine Bluff Arsenal starts destroying its chemical weapons using incineration technology. The Aberdeen chemical weapons disposal facility completes disposal operations in April of its mustard agent stocks without injury to any person or the environment. The Newport chemical neutralization plant starts disposal operations in May. In June, the Army announces that all nerve agent munitions and containers (including 7,400 tons of agent) at Tooele's chemical disposal facility have been destroyed.

cont.

In April 2005, a federal judge grants DoD the flexibility to give the anthrax vaccine in emergency circumstances on a volunteer basis to service members under certain conditions.

DoD releases letters in May showing that al Qaeda operatives in Afghanistan had commenced the assembly of equipment necessary to build a rudimentary BW laboratory. An unnamed scientist claims in the letters that he was shown a special room containing thousands of biological samples, although no BW agents were discovered in Afghanistan after the U.S. invasion.

In December 2005, the FDA reaffirms its earlier finding that the anthrax vaccine used by the military is safe and effective for preventing all forms of anthrax.

2006 DoD releases its *National Military Strategy to Combat Weapons of Mass Destruction* in February. The strategy outlines eight mission areas within the capability focus of combating WMDs, describing the U.S. military's response to an adversarial nation's desire to develop, store, and potentially use nuclear, biological, and chemical weapons.

5

Biographical Sketches

As a brief introduction, these biographical sketches are short summaries of notable people who significantly influenced aspects of chemical and biological warfare. The flip side of that notoriety is that because CB warfare specialists represent a relatively insular community, there's not much information as to their births, education, lives, and accomplishments other than the few particular events that they directly influenced. Similarly, there are particular famous personages who have taken significant positions on the issue of CB warfare, and I will not attempt to capture their entire career here, as other sources will have already done so.

Dr. Kenneth Alibek (1950–)

Ken Alibek was born as Kanatjan Alibekov in the Soviet Republic of Kazakhstan. He joined the military and was educated in military medicine, specializing in infectious diseases and epidemiology. In 1975, he joined the Soviet Union's Biopreparat, a state-owned pharmaceutical organization whose secret mission was to research and develop BW agents and munitions. He would eventually rise through the ranks to become a colonel in the Soviet Army and first deputy director of the Biopreparat. While Alibek had no concerns about the Soviets' violating the BWC through the organization's work, he noted in his book *Biohazard* that he began to have doubts following an official state visit to the U.S. Army's Pine Bluff Arsenal. The Soviet group had

expected to see evidence of an active U.S. offensive biological weapons program, but no such evidence existed.

In October 1992, Alibek defected to the United States and provided details of the Soviet Union's BW program. It was at that time that the U.S. government began to realize the large scale of that country's efforts. For instance, the Soviet Union had four major anthrax production facilities, the largest of which could manufacture more than 300 tons within a year. More than 60,000 people had been employed in the program during the late 1980s and early 1990s. Alibek had been involved in developing an improved form of smallpox, while others were developing anthrax, plague, tularemia, glanders, and Venezuelan equine encephalomyelitis as strategic and operational-level weapons. Other scientists were attempting to genetically modify viruses to be antibiotic-resistant or to suppress immune systems, studying peptides with psychogenic or neurogenic effects, and testing facilities to verify their readiness to quickly mobilize and produce tons of agent in time of war.

While Russia abandoned its offensive BW program in 1992, Alibek noted in 1998 that it was still possible that Russian scientists were continuing their work through legitimate medical research channels (Alibek 1998). Today, Dr. Ken Alibek is a well-respected U.S. consultant and speaker on the issue of BW research and defense.

General Pietro Badoglio (1871–1956)

Pietro Badoglio joined the Italian Army and was a junior officer in Ethiopia and Tripolitania, prior to his experiences in World War I where he ascended to become the chief of staff to the commander in chief of the Italian army in 1918 (despite his role in the defeat of Italian forces at the battle of Caporetto in 1917). He was not an admirer of Benito Mussolini but became the governor of Libya in 1928, and in 1936 led Italian troops in the conquest of Ethiopia. Badoglio had replaced the previous general after the slow and cautious advance of Italian troops. Abyssinian guerrillas were attacking the flanks and rears of Italian columns as these troops were moving through the mountains, so Badoglio decided to use mustard agent to deny the terrain from enemy use. Because the guerrillas were barefoot and wore little in the way of clothing, the mustard was very effective in causing the guerrillas to leave the Italian columns alone. When in January 1936 Italian

forces were surprised by a large force of Abyssinians, the Italian air force struck the enemy's flanks and rear with mustard bombs and sprays. While there was no immediate effect, within four days the armies of Haile Selassie were in full flight. Badoglio's forces took the capital Addis Ababa on May 5, 1936. Badoglio resigned from the Italian army in December 1940 but came back in September 1943 as the prime minister of Italy; he negotiated and signed the Italian armistice with the Allies upon the collapse of Benito Mussolini's government.

Sir Frederick Banting (1891–1941)

Frederick Banting's primary fame can be attributed to his discovery in 1922 of how to extract insulin from the pancreas to treat people afflicted with diabetes. He received the Nobel Prize in Medicine in 1923 for this work and was the first Canadian to receive the Nobel Prize in any field. In late 1939, Banting was concerned that the British government was not taking the threat of biological warfare seriously, and he became a strong advocate of beginning research on offensive and defensive measures as soon as possible. While the topic of biological warfare was not his area of expertise, he believed that it was a very real threat and campaigned vigorously to obtain funds and permissions to start a research effort in Canada. In November 1940, he received permission from the Canadian government to start an offensive BW research program in coordination with the British and U.S. governments. This would eventually lead to the production and testing of anthrax munitions in Canada for the general war effort. In February 1941, he was killed in an air crash in Newfoundland, but his work initiated important U.S.-Canadian-British cooperative research on a dangerous military threat.

Dr. Wouter Basson (1951–)

Wouter Basson was in charge of the South African CB weapons program; he claimed that this program was developed in response to the alleged use of chemical weapons by Cuban troops who were supporting the Angolan government against South African military forces. Basson was appointed director of Project Coast in 1981. Its purpose was to develop CB warfare agents to

be used as counterinsurgency weapons as well as a tool against Angolan forces. While South Africa had acceded to the Geneva Protocol of 1925 and BWC, the government had decided that a CB weapons program would be an effective measure for military and counterterrorism operations. Basson set up a network of front companies to procure equipment, materials, and precursors for his research. On the chemical side, the research and development was primarily limited to riot control agents and incapacitants, although small quantities of sarin, tabun, mustard, and agent BZ were manufactured. On the biological side, the program developed anthrax, botulinum toxin, cholera, plague, and salmonella. A good part of their research also appears to have been focused on developing chemical and biological materials that would affect the black population and not the whites.

In 1988, the South African government recognized that the Soviet Union's support for Angola was collapsing and they were going to win, meaning they did not require CB weapons to support those military objectives. When President F. W. de Klerk became president in 1989, he decided to begin the dismantlement of Project Coast and other military initiatives. It took about three years for the government to commercialize the front companies and dismiss the personnel. Basson was retired from the South African Medical Services in 1993 and ordered to destroy all the Project Coast documentation. He then went to Libya on contract for at least two years to give their military advice on countermeasures to CB warfare attacks. In August 1998, he was arrested and charged on seventeen counts, including murder, conspiracy to commit murder, fraud, and possession of and dealing in illegal substances. His trial began in October 1999, at which time he received the nickname "Dr. Death." The case against him fell apart after the judge ruled that crimes committed in other countries could not be held against him, and that much of his effort had been government sponsored. In April 2002, Basson was freed on all charges, and the government lost an appeal to retry him in 2003. He remains at liberty, traveling around the world as a guest speaker.

President George H. W. Bush (1924–)

George Bush was born in Milton, Massachusetts, and joined the U.S. Navy in June 1942, fighting as a naval aviator through World

War II. He entered Yale University in the fall of 1945, and upon graduation, entered the oil industry in West Texas. He was elected to the House of Representatives in 1966 and 1968, unsuccessfully running for the Senate in 1970. He served in several top positions for the Ford administration and returned to the commercial sector prior to his selection as the vice presidential nominee in 1980. As the vice president, Bush cast three tie-breaking votes in the House to allow the production of binary chemical weapons to begin at Pine Bluff. At the same time, he was supporting arms control negotiations at Geneva, working toward a worldwide ban on the development, production, stockpiling, transfer, and use of chemical weapons.

When Bush was elected president in 1988, he continued the bilateral talks at Geneva. In 1990, his administration would be responsible for moving U.S. chemical weapons from Germany to Johnston Island, 800 miles southwest of Hawaii, without incident. At the same time, he and Defense Secretary Dick Cheney would have to face the threat of CB warfare from Saddam Hussein, as U.S. forces deployed to Saudi Arabia and then routed the Iraqi army out of Kuwait. Because of the increase in defense funds through the 1980s, the U.S. military was able to protect itself from potential CB warfare during the Gulf War.

Prime Minister Winston Churchill (1874–1965)

Winston Churchill was born in Woodstock, a small town in Oxfordshire, England; graduated from Sandhurst, the Royal Military Academy; and joined the army. After five years in the military, he left for a career in politics. He became the first lord of the Admiralty in 1911 and held that post through World War I. As early as 1915, he was encouraging the British army to use CW agents in battle and actively supported research into new agents and delivery systems. After moving through several government positions, he returned to the position of first lord of the Admiralty at the outbreak of World War II, and was appointed prime minister in 1940.

As much as Franklin Roosevelt may have eschewed chemical warfare, Winston Churchill demanded more offensive capability to protect the United Kingdom from German invasion. In

1940, Britain had a very small gas stockpile—perhaps 410 tons—which its forces could use to counter the threat of a German invasion. Through support from private American firms and overseas production in South Africa, Churchill was able to increase military stocks to more than 15,000 tons of phosgene, mustard, and other gases by December 1941. Simultaneously, the British civil defense efforts increased to provide millions of gas masks for civilians, early warning systems, and decontamination apparatuses. Perhaps most famous is his statement in 1944 when he noted to his chiefs of staff, “I may certainly have to ask you to support me in using poison gas. We could drench the cities of the Ruhr and many other cities in Germany in such a way that most of the population would be requiring constant medical attention. . . . I want the matter studied in cold blood by sensible people and not by that particular set of psalm-singing uninformed defeatists which one runs across now here now there” (Spiers 1986, 81). Fearing the German use of gas during the invasion of France in 1944, the Allies had tons of phosgene in bombers prepared to retaliate against the Germans.

Churchill also advocated the strategic use of anthrax as a retaliatory weapon against Germany, ordering the manufacture of five million anthrax-infected cattle cakes, which would have been dropped by bombers over the German landscape and cities. One scientist assessed that about two thousand cakes might be enough to take out Stuttgart, given a cloudy summer day. Following the war, Britain destroyed the anthrax cakes. While German and British government officials hurled accusations and threats at each other, neither pushed the war into a CB battle. Churchill was defeated in 1945 but would return to the prime minister seat in 1951, retiring in 1955. Interestingly, it was not until 1956 that Britain decided to abandon the option of offensive chemical warfare.

General William M. Creasy (1905–1987)

William Creasy was born in Wilmington, North Carolina, and graduated from the United States Military Academy in 1926, choosing a commission in the Air Service. He transferred to the Chemical Warfare Service in 1930, and after a number of assignments in production and manufacturing areas, was promoted to chief of the Inspection Division, Edgewood Arsenal, in 1943. The

following year he attended and graduated from the Army and Navy Staff College and was assigned duty as chief of the United States Plans Section, Allied Forces, East Asia. Before the end of World War II, Creasy became chief of the Planning and Control Division, United States Forces, China-Burma-India Theater.

Following World War II, Creasy served in a number of staff positions, eventually becoming commander of the Edgewood Arsenal in 1951. Major General Creasy was appointed chief chemical officer in 1954, a position he held for four years. Under his service, the Chemical Corps standardized nerve agents, developed and improved gas protection and detection systems, and experimented with incapacitants, including Agent BZ and LSD. Given the heavy U.S. military casualties of the Korean conflict, there was significant interest in developing nonlethal means to subdue large numbers of the enemy and to avoid such massive losses in future conflicts. Creasy testified before Congress and many public venues on this topic.

Major General Creasy retired from the Army in 1958. He had been awarded, during his career, the Distinguished Service Medal, Legion of Merit, Bronze Star, and Army Commendation medals. Following his retirement, he became vice president and director of the Lumus Engineering Development Center.

Major General Amos A. Fries (1873–1963)

Amos Fries was born in Viroqua, Wisconsin, graduating from the U.S. Military Academy, seventh in his class, as an engineer in 1898. He had fought under Pershing in the Philippines in 1901. After his tour in the Philippines, he supervised the early construction of the Los Angeles harbor as the district engineer for Southern California and was the engineer of Yellowstone National Park, prior to re-joining Pershing in 1917. Pershing appointed Fries as chief of the Gas Service in August 1917, as more than 12,000 American troops were within twenty miles of the front lines without any gas masks or chemical warfare training. By working with the British and French militaries, Fries went about organizing gas personnel in the Army, obtaining gas warfare supplies, and establishing a chemical warfare school in France. He also outlined the need for offensive gas weapons, basing his recommendations on the British Special

Brigade, which used four-inch Stoakes mortars. In January 1918, the First Gas Regiment (formerly the 30th Engineers) arrived from the United States to support offensive gas operations under his direction.

Following the end of the war, there was a great degree of public opposition toward the future use of chemical weapons, largely based on newspaper articles during the war and the stories of returning veterans. Fries launched a public relations campaign to save the newly named Chemical Warfare Service from being disbanded by the War Department, enlisting the American Chemical Society (an organization keen on advancing its industry in the 1920s) to his aid. Against the idea that poison gases used during war would inevitably kill noncombatants, he stressed the need for the U.S. military to have chemical weapons, claiming that future enemies would be far less likely to attack it with chemical weapons, knowing that the United States would retaliate in kind. He successfully argued that the military ought to have its own capability to produce large quantities of CW agents without notice, resulting in the investment of \$40 million (a huge sum for a single military project at the time) in construction projects for production plants and the training school at Edgewood Arsenal, Maryland.

Fries was promoted in 1919 to brigadier general, heading the Chemical Warfare Service, Overseas Division. In 1920, he became the Chemical Warfare Services' first peacetime chief and was promoted to major general in 1925. He remained in that capacity until his retirement in March 1929. Throughout his tenure as chief of the Chemical Warfare Service, he adroitly kept the service tied with industry by promoting the peacetime military research that benefited the U.S. agriculture and mining industries.

Dr. Fritz Haber (1868–1934)

Fritz Haber was born in Breslau, Germany, graduating from the University of Heidelberg in 1891. He entered a career in chemistry and was appointed professor of physical chemistry and electrochemistry and director of the Karlsruhe Institute in 1906. His focus was on relating chemical research to industrial processes, including his work on the fixation of nitrogen from the air. Between 1905 and 1914, he was successful in synthesizing ammonia by circulating nitrogen and hydrogen over an iron catalyst at a temperature

of 500 degrees Centigrade (this is still known as “the Haber process”). This work allowed Germany to synthesize ammonia for explosives during World War I when its supplies of nitrates (delivered from South America) had run out. He received the Nobel Prize in Chemistry for this work in 1918 (awarded in 1919).

He is, of course, most famous for his consulting work to the German War Office during the First World War, where he organized gas attacks and defenses against them. While Haber was not the first German scientist to weaponize gas, he was the most successful (as discussed in chapter 1). Haber was a rabid patriot, and following the war, he tried to develop a process to recover gold from sea water to help Germany meet its war reparations. He continued to work in the field of chemistry until 1933, when Nazi race laws forced nearly all his staff to resign (Haber was also a Jew) and he left Germany to live in Cambridge, England.

Major General John J. Hayes (1914–2004)

John Hayes was born in Chicago, Illinois, and graduated from Washington University in St. Louis, Missouri, in 1935 with a bachelor's degree in chemical engineering; he went on to obtain master's and doctoral degrees in public welfare administration from Catholic University of America in Washington, DC. Following the beginning of World War II, he served in the European Theater of Operations, detailed to the Free French Forces as a combat liaison officer. After the war ended, he returned to Washington to continue his career in the military.

In March 1952, he assumed command of Pine Bluff Arsenal at a time when the arsenal was the largest industrial installation of the Chemical Corps. He oversaw a number of classified projects, including completion of the Army's anti-personnel BW production plant and the movement of chemical weapons to Okinawa as a strategic retaliatory option for U.S. forces in Korea. Between 1954 and 1957, he commanded Fort Detrick while its laboratories were busily developing BW agents and defenses against their use. He developed war plans for U.S. forces in Europe and coordinated with NATO between 1960 and 1961, then returning to Washington prior to assuming the position of

deputy commander for the Army's Chemical Biological Radiological Agency at Edgewood Arsenal, Maryland, in 1962.

In 1964, Hayes was promoted to brigadier general and transferred to Korea as a senior logistics advisor to the Republic of Korea army. He returned to the United States to accept a short command of Deseret Test Center in 1966, was promoted to major general and given an acquisition assignment in Washington. After three years in acquisition assignments, he was made the assistant deputy chief of staff for logistics. When the Japanese government learned about the chemical weapons at Okinawa, he was ordered to oversee the movement back to the United States of the chemical weapons he had sent to Okinawa in 1952. This was a particularly delicate time, as the U.S. government was discussing the return of Okinawa to Japan, and combat operations in Vietnam were heating up. Major General Hayes and his staff planned the construction of storage facilities on Johnston Island, planned the movement of the munitions and trained personnel for the mission, and transferred the more than 12,500 tons of chemical munitions across the Pacific Ocean without incident. His last act on Okinawa as the ranking military officer was to formally turn over the "keys to the island" to the Japanese government on May 15, 1972. He retired in August 1972 with thirty-seven years of military service.

President John F. Kennedy (1917–1963)

John Kennedy was born in Brookline, Massachusetts, and graduated from Harvard University in 1940. After a career in the Navy during World War II, he became a Democratic congressman and advanced to the Senate in 1953. After winning the presidential election in 1960, he was faced with a number of military challenges, including support to a Cuban exile group in its efforts to overthrow Fidel Castro, facing down the military threats of the Soviet Union in Cuba and Europe, and sending American advisors to Vietnam.

In 1962, Kennedy approved the use of herbicides in Vietnam under the name Operation Ranch Hand. This controversial program initially targeted crops but was expanded to defoliate areas where the enemy was ambushing U.S. troops. It was during his administration that the Department of Defense expanded its of-

fensive weapons testing program with Project 112, a comprehensive program for testing the vulnerability of U.S. forces against CB warfare agents, often using large-area dissemination of chemical and biological simulants as well as agents. Part of the logic of increasing the potential use of CB warfare agents was the desire to back away from the strategy that had become known as “mutually assured destruction” through nuclear conflict with the Soviet Union. If the United States used CB weapons in retaliation against Soviet CB weapons, it would avoid an escalation to tactical, and then strategic, nuclear weapons. Project SHAD (Shipboard Hazard and Defense) tests were part of Project 112.

Captain Alfred T. Mahan (1840–1914)

Alfred Mahan was born in West Point, New York; he attended Columbia University for two years prior to transferring to the Naval Academy, where he graduated second in his class in 1859. As a lieutenant, he participated in the Civil War in support of the Union fleet, and continued to serve on Navy vessels until 1894. He was president of the Naval War College between 1886 and 1889. His career at sea was not remarkable for a scholar who was to eventually write 137 scholarly articles and 20 books, the most famous being *The Influence of Sea Power upon History* (1890). He retired from active duty in 1896 but remained a member of the Naval War Board through the war between the United States and Spain.

He was an appointed U.S. delegate to the peace conference at the Hague in 1899, supporting talks of the naval subcommittee. He discussed (among other issues) prohibiting the use of projectiles “the sole purpose of which was, on bursting, to spread asphyxiating or deleterious gases” and cast the sole vote against it in the committee. His rationale (which is printed in full in chapter 1) was that no one could really state for a certainty that there was anything more or less merciful about using poison gas shells as opposed to conventional shells, and that it was illogical to be “tender about asphyxiating men with gas, when all were prepared to admit that it was allowable to blow the bottom out of an ironclad at midnight, throwing four or five hundred into the sea, to be choked by water, with scarcely the remotest chance of escape” (Avalon Project 2005).

Matthew S. Meselson (1930–)

Matthew Meselson was born in Denver, Colorado, and graduated from the University of Chicago with a degree in chemistry in 1951. He obtained his doctorate in biology at the California Institute of Technology (Caltech), Pasadena, in 1957. His experiments on DNA led to the discovery that DNA replication was semi-conservative, meaning that when the double-stranded DNA helix was replicated, each of the two double-stranded DNA helices consisted of one strand coming from the original helix and one newly synthesized.

Meselson joined the Arms Control and Disarmament Agency as a resident consultant in 1963, resulting in his involvement in CB defense arms control in several issues. During President Nixon's review of the U.S. offensive biological weapons program, Meselson was influential in building the case to unilaterally disestablish the program, largely on the claim that BW agents were not sufficiently reliable and not necessary, given the availability of nuclear weapons. He also believed that further research into offensive BW efforts might encourage other nations to follow suit. He initially believed that the Sverdlovsk anthrax incident in 1979 was "an outbreak of gastrointestinal anthrax" rather than an accidental release of weaponized anthrax (McDermott 1987, 41) and discounted the U.S. government's claim that the Soviet Union had used trichothecene mycotoxins against Hmong tribes in Laos in the 1980s. He later recanted (Meselson 1994). Meselson remains active in the international CB arms control area, notably as one of the lead principals in the Harvard-Sussex Program on CB Weapons Armament and Arms Limitations.

President Richard M. Nixon (1913–1994)

Richard Nixon was born in Yorba Linda, California, and graduated from Whittier College, a local Quaker school, and Duke University Law School before becoming a lawyer. He served as a Navy lieutenant commander in the Pacific during World War II. Entering politics after the end of the war, he won a Senate seat, representing California in 1950. He served as vice president under President Dwight Eisenhower, lost a presidential campaign to John Kennedy, and was elected president in 1968.

Nixon's administration has been noted for its push to increase world stability by lessening tensions with China and the Soviet Union, largely through arms control negotiations, such as the Nuclear Non-Proliferation Treaty, the Anti-Ballistic Missile Treaty, and Strategic Arms Limitation Talks. In chapter 2, I noted President Nixon's impact on CB warfare policy, the most famous moment of which was when he announced, on November 25, 1969, that the United States would unilaterally abandon its offensive BW program and maintain a "no-first-use" policy in regard to chemical weapons use (National Security Archives 2006). All of the military's BW agents were destroyed by 1973. The Army also initiated its chemical demilitarization efforts in 1972 to dispose of aging World War II chemical munitions as well as other chemical munitions that were leaking.

William C. Patrick III (no dates)

William C. Patrick III is perhaps one of the few surviving and definitely most outspoken experts on U.S. biological weapons development, having more than fifty years of experience in the field of biological warfare. From 1965 to 1972, he was chief of the Product Development Division of the Agent Development and Engineering Directorate for the Army's Biological Warfare laboratories at Fort Detrick, Maryland, responsible for developing and producing many of the BW agents in the U.S. military's arsenal. He was responsible for groundbreaking work on weaponizing plague and tularemia as well as participating in open-air tests in the Pacific. When the American bioweapons program was discontinued, he stayed on at Fort Detrick to plan, direct, and coordinate research on medical defenses against potential biological agents until he retired from government service in 1986.

Prior to the Persian Gulf conflict, Patrick was called to testify before Congress on the potential threat of anthrax attacks against U.S. forces. When Soviet BW researcher Ken Alibek defected to the United States in 1992, the CIA asked Patrick to assist in the debriefing of Alibek. Following the Persian Gulf conflict in 1991, Patrick participated in the United Nation's team of monitors who investigated the Iraqi government's BW research, visiting Iraq in 1994. When the anthrax letters hit the United States in October 2001, he was widely sought for advice and news story quotes. He

now acts as a consultant to the FBI, the Defense Intelligence Agency, and the CIA.

General John J. Pershing (1860–1948)

John Pershing was born near Laclede, Missouri, and graduated from the U.S. Military Academy at West Point as an infantry officer in 1886. He was involved in the Indian campaigns as a lieutenant and fought in the Spanish-American war as a captain of cavalry troops in Cuba. After a notable military career with many overseas assignments, he was appointed by President Theodore Roosevelt to the position of brigadier general (from his current rank as a major) in 1906. In 1916, he was sent to chase down Pancho Villa in Mexico, but was unsuccessful in capturing the bandit.

President Woodrow Wilson appointed Pershing (now a two-star general) to command the American Expeditionary Force in 1917, where he had to coordinate with the British and French militaries while building his own army's presence in Europe. Acknowledging the challenge of gas warfare, he appointed his chief engineer—Lieutenant Colonel Amos Fries—to prepare the military personnel for that challenge. When Fries protested that he didn't know anything about gas, Pershing responded, "That's okay. Learn" (Smythe 1986, 40). Fries had to organize the equipping and training of the entire force in Europe and create a Gas Services to employ gas weapons against the Germans, largely by working with the British and French militaries on gas offense and defense. Pershing remains the only American general officer in history who commanded major operations during a conflict that featured the offensive use of chemical weapons.

In his final report to Congress on World War I, Pershing made the famous statement "Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question." However, Pershing was not a proponent of the U.S. Army's maintaining an active chemical weapons program. When the War Department wrestled with the decision about whether to keep the Chemical Warfare Service active following the war, he was against it, preferring instead that chemical warfare be outlawed and thus removed as a future threat. (This attitude has re-

mained common to infantry officers since then.) Pershing retired in 1924 as a four-star general officer with the title of "General of the Armies," bestowed upon him by Congress.

Major General William Porter (1886–1973)

Major General William Nichols Porter was born in Lima, Ohio. He graduated from the United States Naval Academy in 1909 and served as an ensign aboard the battleship U.S.S. *Connecticut*. He resigned from the Navy in February 1910 and joining the Coastal Artillery Corps as a second lieutenant. He served in a number of positions, including one overseas tour, but did not fight in World War I. It wasn't until after his promotion to major that he changed service branches, joining the Chemical Warfare Service in 1921. He was assigned duty in the Office of the Chief, Chemical Warfare Service. Because the period between world wars was not too busy for anyone in the military, let alone the Chemical Warfare Service, he slowly rose through the ranks and was promoted to lieutenant colonel in 1933.

Promoted to colonel in 1938, Porter was transferred to become chemical officer of the General Headquarters Air Force, Langley, Virginia, in 1940. On June 2, 1941, he became chief of the Chemical Warfare Service (CWS) and received promotion to major general. He immediately began preparing the CWS for a role in the upcoming war. Programs were developed to update defensive equipment, but since Porter considered "defense" a "weasel word," new research programs were developed that fostered the 4.2-inch chemical mortar, new efficient smoke generators, effective flame throwers, and incendiary bombs. As chief of CWS, Porter was personally responsible for providing the U.S. with the ability to wage chemical warfare on a meaningful scale, greatly expanding the number of personnel in the branch as well as overseeing a new biological warfare program and revitalized chemical warfare program. He believed that to create the illusion of chemical capability under one of the other service branches would be to invite an enemy to undertake chemical warfare when that attack might otherwise have been deterred. Major General Porter retired from the Army in November 1945.

President Ronald Reagan (1911–2004)

Ronald Reagan was born in Tampico, Illinois, and graduated from Eureka College in 1932 with degrees in economics and sociology. He had a long career in Hollywood between 1937 and 1964 before turning to politics in 1964. In 1966, he was elected California's thirty-third governor, serving two terms in office. In 1980, Reagan gained the Republican nomination for president and won the election, becoming the oldest president to enter office at the age of 69.

President Reagan would inherit the issue of whether the U.S. government should reinstitute its offensive chemical weapons program. The Carter administration had considered submitting a budget that included this issue, based on four years of unsuccessful arms control talks with the Soviet Union and the reports in April 1979 that an anthrax outbreak in Sverdlovsk was caused by a release from a BW production plant. While arms control experts met in Geneva in 1980 to discuss negotiations toward a Chemical Weapons Convention, there was some movement in Congress toward building a binary chemical weapons plant at Pine Bluff Arsenal. When Reagan submitted a supplemental request that included \$19 million to equip that facility, other congressmen began to demand hearings on the issue. While Congress had approved funds for the construction of the facility, it had not approved funds to produce any chemical weapons.

The use of CB weapons had been reported in both the Soviet invasion of Afghanistan and the Iran-Iraq War, causing more politicians to become concerned about the need for a retaliatory capability. In January 1985, Reagan appointed a Chemical Warfare Review Commission whose task was to determine whether production of binary chemical munitions was in the best interest of the nation. The commission reported back in April that such a capability was required, and in June Congress approved the Defense Department's request to begin production of binary chemical weapons following the completion of the facility at Pine Bluff Arsenal. General Secretary Mikhail Gorbachev began bilateral discussions with President Reagan that same year. In 1986, Reagan promised German Chancellor Helmut Kohl that he would remove all U.S. chemical munitions from Germany by 1992.

While the binary weapons program would suffer problems and not produce completed binary munitions prior to its shutdown in 1990, many officials believe that the threat of modern chemical weapons in the U.S. arsenal triggered the Soviet Union's desire for final negotiations toward chemical disarmament.

President Franklin D. Roosevelt (1882–1945)

Franklin Roosevelt was born in Hyde Park, New York, and graduated from Harvard and Columbia Law School with the intent of going into corporate law. He entered politics in 1910 and was assistant secretary of the Navy between 1913 and 1921. He contracted polio in the summer of 1921 but recovered sufficiently by 1928 to reenter the political field. After two terms as New York's governor, he successfully ran for president and was inaugurated in 1933. Roosevelt was not a fan of chemical warfare, calling it an inhumane weapon and "contrary to what modern civilization should stand for." He vetoed a bill calling for the establishment of a Chemical Corps in 1938, although he was supportive of the massive defense effort that year aimed at expanding and modernizing the armed forces.

When war broke out in 1941, the United States was faced with the possibility of CB warfare on both fronts. The U.S. military's chemical weapons stockpile was very low, and most defense analysts of the era had predicted chemical warfare attacks against major cities as the future form of warfare. Based on Stimson's advice, Roosevelt approved the initiation of a BW research organization in May 1942, and in April 1943, the Chemical Warfare Service started construction of a BW research center at Fort Detrick. In June 1942, he issued the nation's first retaliatory policy, warning the Japanese government that if it continued to use poisonous gases against China or any other nation, Roosevelt would consider it an attack against the United States and retaliate "in kind and in full measure." In June 1943, he expanded this policy to address Germany and Italy, stating, "We shall under no circumstances resort to the use of such weapons unless they are first used by our enemies. . . . Any use of gas by any Axis Power . . . will immediately be followed by the fullest possible retaliation

upon munition centers, seaports, and other military objectives." This became known as the "no first use" policy, which was in line with the Geneva Protocol of 1925.

Perhaps ironically, the U.S. CB warfare arsenal grew tremendously between 1941 and 1945, with chemical warfare arsenals created at Huntsville, Alabama; Pine Bluff, Arkansas; and Denver, Colorado, in addition to Dugway Proving Ground and Camp Detrick. The Army spent about \$2 billion on Chemical Warfare Service activities, raised a force of over 66,000 chemical specialists (fewer than 2,000 existed in 1940), and manufactured more than 147,000 tons of CW munitions by the end of the war. While bloody battles raged in the Pacific, there was discussion of using gas against Japanese-held islands and Japan proper, but Roosevelt's fierce opposition to gas warfare, combined with the reluctance of Pacific Theater commanders to dedicate transportation assets to move the munitions overseas, kept that option off the table.

Dr. Gerhart Schrader (1903–1990)

Gerhart Schrader was born in Bortfeld, Germany, and studied chemistry at Braunschweig University. He was employed by IG Farben to develop insecticides, and in 1936, he was experimenting with organophosphate compounds when he discovered a particularly potent chemical that killed insects in doses of one part in 200,000. In 1937, he continued trials to create what would eventually result in the first nerve agent, tabun. Tests on animals demonstrated the rapid lethal effects of the colorless and odorless liquid. A year later, he headed a team that would discover a second nerve agent, sarin. The term was an acronym of the four key individuals on the team: Schrader, Ambros, Rudriger, and van der Linde.

Discovering the chemical agents did not mean the Germans had an immediate weapon in their hands. Not until June 1942 did the Germans have a full-scale tabun production plant built at Dyerfurth-am-Oder (now Brzeg Dolny in Poland). The corrosive nature of the chemical precursors and the need to constantly decontaminate the plant equipment caused significant challenges. By the end of the war, the Germans had produced 12,000 tons of tabun. Two sarin pilot production plants were built—one at Dyerfurth and one at Spandau—and the Germans were working on a full-scale plant

at Falkenhagen, southeast of Berlin (it was not completed prior to the end of the war). The Soviets captured the sarin facility and documents that described the discovery of a more persistent nerve agent, soman. The U.S. and U.K. military forces captured several German scientists and one of the sarin pilot plants. After cooperating on the extent of his research, Schrader was released in mid-1946 and returned to work in Germany in the field of organophosphate pesticides.

Lieutenant General Ishii Shiro (1892–1959)

Ishii Shiro was a member of the Japanese Army and was schooled in medicine at the Kyoto Imperial University prior to his studies in chemical and biological warfare. In 1932, he convinced the Japanese government to support the establishment of a human experimentation center to develop concepts of how to test and develop biological warfare agents. In 1936, his work expanded into building a BW research center near Harbin, China, in 1936. This center was named the Epidemic Prevention and Water Supply Department, but the more common name was Unit 731. This was one of several secret, detached units created to test biological weapons that would later be used against Chinese cities. His continued experiments led to the building of a larger permanent facility about forty miles from Harbin at a village called Pingfan. This facility was completed and was conducting further research by 1939. By this time, Ishii's network included more than 10,000 personnel, with about half assigned to laboratories in Tokyo and Pingfan.

Ishii's scientists examined a broad number of biological agents, including anthrax, botulinum toxin, cholera, dysentery, smallpox, plague, salmonella, and many other biological organisms. The Japanese experimented with more than 800 Chinese prisoners to identify how to better develop the organisms as weapons. After the experiments, the Japanese military tested biological munitions in their attacks on Chinese cities, largely through attacks using bombers. These attacks were less than successful by military measures—while Chinese deaths occurred, the numbers of casualties were low with one exception in 1942, where a massive attack using cholera resulted in more than

10,000 casualties. More than 1,700 Japanese soldiers died from cholera as well. The Japanese Army lost their confidence in the efficacy of biological weapons after 1942, although Ishii would keep his studies active through the end of the war.

When the Soviet Union overran the Japanese military facility in September 1945, its forces captured documents that laid out the biological warfare facilities and their products. The United States granted Ishii and his scientists immunity from war crimes in return for their disclosure of their BW research efforts. While the Soviet Union pushed to have these Japanese scientists face trial for their war crimes, the United States kept all evidence from being disclosed to deny this information to the Soviets.

Major General William L. Sibert (1860–1935)

William Sibert was born in Etowah County, Alabama, and graduated from West Point in 1884 as an engineer officer. After working on bridges in the Midwest, he saw service in the Philippines before returning to the United States to work on engineering projects. He was appointed to the Isthmian Canal Commission to develop and implement plans to construct the Panama Canal's Atlantic entrance between 1908 and 1914. For this work, he was promoted to brigadier general in 1915. In July 1917, he was promoted to major general and was made the commanding general of the 1st Infantry Division, as the unit deployed to France. After three months of training, the division moved to the front lines. Pershing had inspected the 1st Infantry Division in October, had been disappointed with the unit's discipline and training, and had marked Sibert as lacking "experience, the energy, [and] the aggressive spirit" needed to lead his unit in combat. In December, Pershing relieved Sibert and two other generals of command, perhaps more to make an example to the other generals than for any signs of defeatism or lack of ability (Smythe 1986, 40).

Sibert returned to the United States to assume command of the Southeastern Department of the Continental Command in Charleston, South Carolina. In May 1918, he was selected to fill the position of chief of the Gas Service, with the responsibility to coordinate the actions of the Army's medical department, ordinance department, signal corps, and engineer corps. Sibert was

recognized as an officer of rank and personality who could overcome bureaucratic obstacles and take quick action, characteristics needed to establish a robust industrial capability for building offensive and defensive chemical warfare materials for the Army. Because the Army leadership saw the need for one agency, not five, to be responsible for gas warfare, the Chemical Warfare Service was formed in July 1918, with General Sibert as the first chief of that service. In this role, he was responsible for all research, development, procurement, and supply of all chemicals to the Army, as well as offensive and defensive gas war training. Sibert retired from the Army in 1920 and went to work at the Alabama State Docks Commission, which constructed the Ocean Terminal at Mobile. Upon the outbreak of war in 1941, the Army opened a chemical warfare training camp in Alabama, which was named after him.

Henry L. Stimson (1867–1950)

Henry Stimson was born in New York City and graduated from Yale University in 1888 as a member of the Skull and Bones secret society. He was appointed secretary of war in 1911 under President William Taft and served during World War I as an artillery officer in France. Serving as secretary of state from 1929 to 1933 under President Herbert Hoover, he was famous for the quote "Gentlemen don't read each other's mail" in reference to the State Department's cryptanalytic office. President Franklin Roosevelt brought him out of retirement in 1940 to serve as the secretary of war again, from where he oversaw the expansion of the military forces and the execution of all military operations. Perhaps his most controversial decision was to recommend to President Harry Truman, as the president's chief advisor on atomic policy, that the United States drop atomic bombs on Japanese cities of military importance to end the second world war.

Stimson was also intimately involved in the execution of the Army's CB warfare program. In 1941, he commissioned a committee headed by the National Academy of Sciences to evaluate the threat of biological warfare. The committee's report recommended that the War Department develop offensive weapons and defensive capabilities, to be used in the event that the Axis powers initiated biological warfare. Following President Roosevelt's approval, the Chemical Warfare Service received permission to

initiate its BW research program. Also in 1941, Stimson put the chief of the Chemical Warfare Service in charge of procuring incendiary munitions. Stimson had reviewed studies on toxic gases and made the decision to significantly increase the military's offensive capability in chemical warfare. However, he was also sensitive to the political and moral issues involved if the U.S. government were to publicly announce its intent to use the weapons. He did believe that the only effective deterrent to gas warfare was enemy fear of American retaliation, but he suggested, "I strongly believe that our most effective weapon on this subject at the present time is to keep our mouths tight shut" (Brophy and Fisher 1970, 50) This strategy was later referred to as "calculated ambiguity," where the U.S. government could warn of a devastating response without specifying details or outlining the results of such an action. While he and General George Marshall discussed using gas weapons against Japan in the event of an invasion of that country, President Truman decided against the option.

Major General Alden H. Waitt (1892–1981)

Major General Alden Henry Waitt was born in Orlando, Florida, but was raised and educated in Boston, Massachusetts. He received his B.S. and M.A. degrees in chemistry from the Massachusetts Institute of Technology. Joining the staff of that institution, Mr. Waitt instructed students in applied chemistry until 1917, when he received a temporary commission as first lieutenant, Gas Defense Service. During World War I, Captain Waitt served as the Gas Officer of the 84th Infantry Division and was deployed overseas as the Gas Officer of the 29th Infantry Division, AEF-France. Returning to the states following the war, Lieutenant Waitt received a regular army commission in the Chemical Warfare Service. Similar to General Porter, Waitt traveled through numerous postings, reaching the rank of lieutenant colonel prior to the onset of World War II.

With the start of World War II, Colonel Waitt took over duty as chief of Plans and Training Division, CWS. Promoted to brigadier general, he served as executive officer of the Chemical Warfare Service, second only to General Porter. He was very involved in the development of incendiary bombs, flame throwers,

and smoke generators, and was a primary supporter of the development of the 4.2 inch chemical mortar and the training of soldiers in the use of this weapon. His son, a lieutenant in a chemical mortar battalion, used this weapon in the fighting of the Pacific Theater. Waitt authored numerous books and articles on chemical warfare and for several years was editor of the *Chemical Warfare Bulletin*. For his outstanding service during this war he was promoted to major general.

Major General Waitt was appointed chief of the Chemical Corps in November 1945 and served in this post until 1949. During his tenure, the newly named Chemical Corps began its research into nerve agents and radiological contamination. Waitt became entangled in an industry scandal, which forced his resignation in 1949. When asked who should replace him, he replied that there was no other officer in the Chemical Corps as capable as he. As a result, the Army civilian leadership appointed an infantry officer, Major General Tony McAullife, as Waitt's replacement. McAullife, most famous for his quote of "Nuts!" during the Battle of the Bulge, was participating as an observer in military nuclear weapons tests in the Pacific at the time. McAullife remains the only chief chemical officer who has ever been promoted above the rank of major general.

Major General Gerald Watson (1935–)

Major General Gerald G. Watson was born in Kilgore, Texas, graduated from Trinity University in 1957 with a degree in chemistry, and was commissioned a second lieutenant in the U.S. Army. After an initial tour as an artillery officer, he switched branches to the Chemical Corps and served in a number of chemical units. In 1964, he was sent overseas to serve as Chemical Operations Officer, Office of the Assistant Chief of Staff, J-3, Military Assistance Command, Vietnam. Returning to the United States in 1965, Watson attended the Command and General Staff College at Fort Leavenworth.

Watson served in a number of staff personnel management positions, and following his position as commander of the Rocky Mountain Arsenal in the early 1970s, he was promoted to colonel. He attended the Army War College, and following his graduation in 1976 became chief of the Chemical, Nuclear, and Biological Defense Division, Nuclear and Chemical Directorate, Office

of the Deputy Chief of Staff for Operations and Plans. While in that position, he and several other Army officers developed plans to build up the shrunken Chemical Corps, revitalize its doctrine and equipment, and return the Chemical School from Aberdeen Proving Ground to Fort McClellan, following the Army's decision in 1976 to reverse General Abram's decision to disestablish the Chemical Corps.

In 1979, Watson was promoted to brigadier general and became commandant of the U.S. Army Chemical School. In 1982, he left to become commanding general and director of the Nuclear and Chemical Directorate, Office of the Deputy Chief of Staff for Operations and Plans. This was followed in 1984 by his assignment as deputy inspector general (Inspections) of the U.S. Army. In 1985, Major General Watson returned to Fort McClellan and became the post commanding officer and commandant of the U.S. Army Chemical School. During his second tour as commandant, the Chemical School opened its Chemical Defense Training Facility, which used small amounts of actual nerve agent in training situations for the students. Watson held this command until 1989, when he left to become director of the Defense Nuclear Agency. He retired from military service in 1992, but remains active as a consultant.

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6

Facts and Data

There is a tendency for both laymen and military analysts to talk about CB weapons as if chemical and biological warfare agents were one and the same threat. The military analysts do this not because they think that the two classes of agents are the same in terms of lethality and effectiveness—they are not—but rather because both classes are considered unconventional weapons and they have very similar employment means and capabilities. This lack of distinction is more of a problem when people use the term *weapons of mass destruction*. The Department of Defense defines weapons of mass destruction as weapons that are capable of a high order of destruction, of being used in such a manner as to destroy large numbers of people, or both. Weapons of mass destruction can be high explosives or nuclear, biological, chemical, and radiological weapons; the definition excludes the means of transporting or propelling the weapon when such method is a separable and divisible part of the weapon.

No one can mistake the destructive force of even tactical nuclear weapons, let alone the big city-busters, yet politicians and arms control advocates talk as if chemical and biological weapons should be considered on the same level as nuclear weapons. This is a dangerous misperception, one that continues to cloud the issue as to the true threat caused by chemical and biological weapons. For that reason, I will avoid the popular but over-used term weapons of mass destruction.

This book uses the term "CB warfare" and "CB weapons" frequently, and this may seem at odds with the above statement seeking to distinguish chemical from biological weapons. Although chemical and biological agents have different scientific

properties and effects, military forces use the two in very similar ways. Chemical and biological weapons are two sides of the same coin, sharing a common source in military laboratories and using similar delivery systems to target people. They harm humans and animals based on their inherent physiological interactions with living matter (as opposed to explosives or piercing weapons), generally attacking through the skin and respiratory tract. They are both delivered by artillery projectiles, aerial bombs, aerial and ground aerosol sprayers, ballistic missiles, even hand grenades as well as through covert operations using small amounts against individual targets. Most chemical and biological warfare agents are largely invisible to the naked eye and have little to no odor; they both can cause mass casualties relatively quickly if disseminated in large quantities over a large area. Chemical and biological weapons both have an unconventional capability for demoralizing, diminishing, or destroying a military force that is unprepared for their effects. Because of these similarities, there is a common defensive approach to respond to these weapons' effects.

The technical and physical properties of chemical warfare (CW) agents are very different from those of biological warfare (BW) agents, and this distinction is important when a nation develops specific defenses for military personnel and civilians. CW agents are not natural to the environment, are relatively quick acting, and cover a much smaller area than BW agents. This means, for instance, that a force needs a larger number of CW detectors to cover a certain area than BW detectors, and the detectors must work much more quickly. There are broad differences within the category of CW agents. Many people, discussing CW agents, fixate on the nerve agents—invisible, odorless, and lethal in a matter of seconds to minutes—but these are not the only chemical weapons available. Some nations still consider the use of phosgene and hydrogen cyanide, both of which have detectable odors and, unless present in large quantities, are not immediately lethal. Mustard agent is not lethal in normal field concentrations; it was chosen for its incapacitating qualities (although complications from exposure—that is, infection—can be lethal).

Most BW agents are natural to the environment and require days to weeks to become infectious. Relatively small amounts can cover large areas if properly developed and dispersed. Inhalation anthrax is certainly the megaton munition in the BW arsenal, with its hardness, lack of visible signs, and almost certain lethality if left untreated. If an anthrax victim is not treated within forty-eight

to seventy-two hours, medical treatment cannot help, and death is a foregone conclusion. People focus on anthrax or smallpox (or some new, engineered, super-lethal, and infectious BW agent they saw in a movie) in their discussions of biological warfare, but most BW agents are much less lethal and yet still quite effective. Smallpox, although very infectious, is survivable, being lethal to only 30 percent of untreated victims. The range of BW agents and their effects is very broad. Many viruses, bacteria, and rickettsia (causing such diseases as brucellosis, tularemia, and Q fever) may sicken a large population, but they have much lower lethality rates. The toxins (poisonous chemical substances produced by biological organisms) act more like their chemical warfare cousins than their biological parents, which increases the diversity of potential BW agents.

Because of the unique aspects of BW and CW agents, military forces can deliver specific agents to achieve specific tactical or strategic effects—on noncombatants, on military forces, or on agricultural industries. The significant differences between BW agents and CW agents call for different technical approaches in developing detectors, protective ensembles, and decontaminants, but the basic means by which an individual uses chemical and biological defense equipment are remarkably similar. The challenge is to identify the unique aspects of chemical versus biological agents and then understand how to develop common defensive equipment for both threats.

Chemical Warfare Agents

CW agents can be categorized in a number of ways. One can categorize them by lethality, as either lethal or merely incapacitating agents, or by their effect on personnel: as choking, blister, blood, nerve, or irritant agents. Another way to characterize them is by how long they remain viable in the environment: there are non-persistent, semi-persistent, and persistent agents. One might characterize chemical warfare agents by their different scientific and physiological effects. This book's approach is to examine the generations of CW agents, that is, what "wave" of development brought particular agents into the military stockpiles.

The first-generation agents were those developed and stockpiled during World War I and up to World War II. These were largely industrial chemicals identified during the early 1900s as

both very toxic and effective on the battlefield. The early gases were generally characterized by their physiological effects: irritants, lacrimators (tear gases), choking gases, blood agents, and vesicants (blister agents). The irritants, or sneeze gases, included adamsite, diphenylchlorarsine, bromoacetone, chloropicrin, dichloromethyl ether, dibromomethylethyl ketone. These gases affected the nose and throat and caused vomiting. They were meant to harass troops and increase the time it would take them to get a protective mask on (the enemy would send more lethal agents into the trenches after using irritants). Lacrimators, or tearing agents, included brombenzyl cyanide, benzyl bromide, ethyl iodoacetate, and xylyl bromide. These agents were used as incapacitants by soldiers as well as by police. Chloroacetophenone (CN) was discovered in 1877 but was not used in World War I because its low vapor pressure made it unsuitable for trench warfare. It was developed as an incapacitant for police forces in the 1920s and was later used in the formula for mace in the 1960s.

The choking agents, or asphyxiants, included chlorine, phosgene, and diphosgene. These gases are heavier than air, so they remain near ground level, filling the foxholes and trenches. They inflict damage by reacting with water vapor in the lungs and forming hydrochloric acid, causing the body to react by flooding the lungs with fluids. Medical professionals call this pulmonary edema; soldiers called it "dry-land drowning." The blood agents hydrogen cyanide and cyanogen chloride inhibit the body's ability to transfer oxygen from the blood to muscles and organs. Because of their high volatility, they had to be used in large quantities as a surprise attack or else they would dissipate and concentrations would decrease to harassing levels rather than lethal levels.

The problem with these first-generation agents was that they were largely nonpersistent, volatile chemical gases that had to be used in large quantities. The chemicals' odors often tipped off the troops being attacked that they were being gassed, especially if the gases were used in large quantity. If the troops had masks and got them on in time, there were few to no casualties. Of course, in some cases, that is all the employing side wanted to do: force the other side to have to don cumbersome masks, limiting their vision and reducing their effectiveness while the attackers came at the trenches. For success, one had to hope for the element of surprise or untrained troops (or both). As troops increasingly used masks and became accustomed to these gases, continued re-

search led to other CW agents, notably the vesicants, or blister agent class.

Mustard agent was the best-known and most effective CW agent of the war, in part because of its delayed effects and effect on the skin, eyes, and lungs. It is often incorrectly referred to as "mustard gas," but it is actually a liquid that is aerosolized for employment against personnel. It caused about three-fourths of all U.S. gas casualties in the war, but phosgene caused most of the deaths. Although mustard agent can kill if an individual is exposed to large enough quantities, its value was more in disabling personnel. Originally, the United Kingdom and United States could not determine how the Germans manufactured their mustard, so U.S. and British efforts could only produce what was called the "Levinstein" mustard. This form had up to 30 percent impurities, but its effects were close enough to those purer agents to impact military operations. Following World War I and capture of German documents, the allied countries developed the technology to make distilled mustard agent similar to what the Germans produced. Nitrogen mustards, developed prior to World War II, have less persistency and less odor than the sulfur mustards and can be sprayed at lower temperatures, but they are not as harmful to the skin.

Other vesicants included ethyldichlorarsine, dibromethyl sulfide, and lewisite, which was developed just at the end of World War I. Lewisite, an arsenic-based compound, is as persistent as mustard agent, can be used in cold weather, and is immediately irritating to the unprotected eyes and skin. Its one drawback: it is not effective in wet weather because it readily reacts with water to become a solid. The United States abandoned the production and stockpiling of lewisite as a CW agent after World War II.

Table 6.1 gives the reader an idea of the toxicity of these first-generation agents. The term of reference used, milligrams per minute per cubic meter ($\text{mg}\cdot\text{min}/\text{m}^3$), is a standard used to identify the toxicity of aerosols and vapors in their effects against humans. The measure used, LCt_{50} , is the lethal concentration for 50 percent of the population.

The second-generation CW agents include the G-series nerve agents: tabun, sarin, soman, and cyclosarin. Cyclosarin, GF, was a nerve agent investigated and abandoned by the U.S. Army. Iraq was thought to have had stocks of GF nerve agent during the Gulf War. These CW agents are actually liquids that

TABLE 6.1
Toxicity of First-Generation Chemical Warfare Agents

Agent	Military Abbreviation	LC ₅₀ (mg-min/m ³)
Chlorine	(none)	19,000
Phosgene	CG	3,200
Diphosgene	DP	3,000
Hydrogen Cyanide	CA	2,500–5,000 (time dependent)
Cyanogen Chloride	CK	11,000
Arsine	SA	5,000
Mustard	HD	1,500 (respiratory), 10,000 (skin)
Phosgene Oxime	CX	3,200
Lewisite	L	1,200–1,500 (respiratory), 100,000 (skin)
Chloroacetophenene	CN	10,000

can be aerosolized into the air, not gases like the first-generation agents, but they do have a significant vapor hazard. They have differing persistencies, with sarin being a relatively nonpersistent liquid and soman being the most persistent agent. Tabun is the easiest to manufacture, but sarin and soman are more toxic. They all act the same: once inhaled, they inhibit acetyl-cholinesterase in the body, which then cannot break down acetylcholine. This excess acetylcholine causes postsynaptic action potentials and activities in the organs; translated, that means the body's muscles start contracting and relaxing violently, leading to cardiac arrest and an inability to breath. Early signs of low level exposures can include miosis (pinpointed pupils), excessive tearing and salivation, headaches, nausea and cramping, shortness of breath, and loss of consciousness.

The real advances of G-series nerve agents are their lack of color and odor, persistence similar to water (not too quick but clearing within an hour), and extreme lethality in small quantities (see table 6.2; LD₅₀ is the dose for percutaneous effects, measured in milligrams for a 70-kilogram man). They are easily weaponized and can be aerosolized for coverage over large areas, or thickeners can be added to increase the time they remain on the ground. Ideally, they are used as inhalation hazards, but in large enough amounts, they can act through the skin. Although sarin acts quicker through the respiratory system, soman, in particular, is twice as toxic, and its effects can become irreversible, requiring exposed personnel to take prompt medical countermeasures if they are to have any chance of survival. This reaction

TABLE 6.2
Toxicity of G-Series and V-Series Nerve Agents

Agent	Military Abbreviation	LC ₅₀ (mg-min/m ³)/LD ₅₀ (mg)
Tobun	GA	400 (respiratory), 1,000 (skin)
Sarin	GB	100 (respiratory), 1,700 (skin)
Soman	GD	50 (respiratory), 350 (skin)
Cyclosarin	GF	No data—similar to GB
VX	VX	10 (respiratory), 6–10 (skin)

is called aging, in which the agent-enzyme complex forms a refractory complex that lowers or eliminates the effectiveness of the antidote. Aging occurs very quickly in cases of exposure to soman (two minutes) but does not occur as quickly in the majority of other nerve agent exposure cases. For example, sarin ages in four to six hours and VX in approximately sixty hours, meaning there is ample time for continued medical treatment. Although these agents are definitely deadly, several researchers and military personnel have been exposed to low levels of nerve agents in the process of research or storage of chemical weapons and survived, with the proper medical care. (The term commonly used within the CB defense community is being "bitten" by nerve agents.)

The second generation of incapacitants include the riot control agent CS, or o-chlorobenzylidenemalononitrile (now you know why the military abbreviates these agents' titles). Because CN powder was not as potent or as stable as some would like, researchers at Porton Down (England's chemical defense center) developed CS powder in the 1950s. It could be disseminated as a solid or vaporized in a pyrotechnic grenade, increasing its potential hazard area. CS quickly became the riot-control agent of choice for the police forces of many nations, and it is still used today by the military for training purposes.

The third generation of CW agents includes the V-series nerve agents. Discovered in the 1950s, VX is a very persistent liquid whose lethal effects rely almost entirely on skin contact rather than from any vapor hazards. This makes it particularly useful for contaminating large tracts of land, such as air bases or seaports or rear-area logistics dumps. Its variants include VE, VG, and VM, all of which share a common organophosphate chemical structure. These liquid agents are also colorless and odorless, and once

absorbed through the skin, they have a much faster reaction time and require less to kill an exposed individual than the G-series agents. VX, for example, is about ten times more lethal than GB. It does not, however, vaporize quickly and blister flesh as portrayed in the popular movie *The Rock*.

The military and the Central Intelligence Agency (CIA) investigated psychochemicals during the development of third-generation agents. The one that was seen as having the most potential was agent BZ, or 3-quinuclidinyl benzilate. This agent is a solid in its natural state, but when exploded or dispersed into the air, it can be inhaled. About a half hour after exposure, it can cause a dream-like hallucination state that could last for days, depending on the dosage. The United States decided it would not make a suitable CW agent, since it could take two to three hours to affect an individual, its effects were unpredictable, and BZ being dispersed could be seen like a large smoke cloud. This has not stopped other countries from developing this agent.

The fourth generation of CW agents were new nerve agents developed by the Soviet Union between the 1970s and 1990s. The *novichok* agents (*novichok* is Russian for "newcomer") are binary CW agents with toxicities similar to VX and with the aging effects of soman. More important, these agents are believed to be made from common industrial and agricultural chemicals that are not prohibited by the CWC Schedule of Chemicals (Willingham 2000). One benefit from this approach is that U.S. military equipment is not necessarily designed to detect and protect against these new agents, and thus U.S. forces would be unprepared against their use. One could argue that because these CW agents are not specifically prohibited by name, their use would not constitute a treaty violation. However, this interpretation obviously violates the spirit of the treaty and would no doubt still be viewed as a chemical weapons attack.

Last, there are different forms of these agents that offer unique aspects of delivery. The nerve agents tabun and sarin can be thickened, by using polymers, to increase their persistency from minutes to hours. There are also dusty agents, in which mustard or nerve agents are applied to a solid carrier, such as silicon dioxide or talc. This aerosolization makes the agents travel farther in the wind, and because the agents have properties similar to those of dust particles, they penetrate protective suits at their interfaces (between the gloves and the suit or between the jacket and trousers of the ensemble). The Germans investigated

dusty mustard during World War II, and Iraq was suspected of using dusty mustard against Iranian military forces in the 1980s.

There are some in the United States and European countries who consider the threat of toxic industrial chemicals to be a potential hazard to deployed military personnel, especially in urban areas of the world, where terrorists or insurgents could easily obtain industrial chemicals. Certainly industrial chemicals such as ammonia, chlorine, diborane, and sulfuric acid are more easily accessible than CW agents; indeed, tankers of these chemicals crisscross the country every day. Although the possibility of terrorists using toxic industrial chemicals exists, the actual probability that military personnel would be attacked with these chemicals and that they would cause a credible operational impact is low. The reason industrial chemicals are not used as warfare agents anymore is that they are just not as toxic as the "classic" CW agents, not by several orders of magnitude. One would require thousands to tens of thousands of gallons to cause a real life-threatening event, and, as in the majority of hazardous material accidents, people can smell the danger and get out of the area prior to any serious health threats.

Many countries (including the United States) are moving toward using CW experts in a health-protection role, employing them to assess industrial sites that could release a toxic industrial chemical if a terrorist were to sabotage a site or if an accident were to occur. Although there may be a certain amount of technical overlap between chemical warfare and hazardous-material handling, it should be stressed that the two areas are distinct: CW agents are super-toxic materials that are employed to create an immediate, operational impact on the battlefield, whereas toxic industrial chemical incidents are more occupational hazards to one's expectations for a full and long life. They should not be confused as being the same threat.

Chemical Weapon Delivery Systems

Military forces desire a few basic features from chemical agents and their delivery systems. They must be able to disperse CW agent efficiently over a large area, and this dispersion must be predictable (to ensure that one's own forces do not run into the hazard). Commanders desire a degree of flexibility that will allow them to attack across the battlefield; that is, they want to attack

frontline combat forces to degrade the enemy's strength, but they also want to attack the rear area combat support forces, which supply and transport the combat forces. This leads to the large variety one sees in CW delivery systems. There are mortar shells, howitzer and artillery projectiles for the close battle, land mines to make it more difficult to negotiate terrain, aerial bombs and sprays to attack the rear area forces, and ballistic missiles to attack ports, airfields, and cities deep inside an adversary's country.

It requires a great deal of CW agent to effectively attack a large area and cause a significant number of casualties—up to one metric ton per square kilometer to have good coverage. In general, there are two kinds of CW attacks: point and line source. Point attacks include those explosive releases from artillery shells, bombs, and mines (and to a degree, bulk-agent filled ballistic missiles—that is, when the warhead bursts open, the contents are released all at once). These normally contain "burster charges" surrounded by a CW agent; when the burster ruptures the munition, the liquid agent is released as a cloud of small droplets.

The limitation of these devices is that too much explosive used to open the shell could burn off the CW agent. Artillery shells typically hold less than ten pounds of agent, so a force must fire a large number of these to cause casualties in a generally limited area. A few bombs can drop a couple hundred pounds of CW agent, covering a larger area with fewer munitions. A single ballistic missile can bring a few hundred pounds of agent; a volley of ballistic missiles can effectively cover an airbase, if properly targeted. Most nations prefer to weaponize chemical munitions for artillery systems; they are cheaper, easier to handle, and easier for personnel to employ.

Bulk release munitions disperse aerosols into the airstream created by the projectile, and base ejection devices push agent out the rear of the projectile. Either of these releases causes the formation of a "line source" of CW agent, dispersing the droplets along the trajectory of the projectile. These technologies are a little more complicated and expensive. Although these two technologies are more effective in dispersing their payloads on target, many nations rely on the tried and true explosive release method. One loses some CW agent, but it is still effective and is less expensive, which counts when one must hurl hundreds of projectiles to affect a large area where enemy troops lurk.

Spray generators, whether mounted on aircraft, on boats, or on ground vehicles, are the most effective form of dissemination.

Spray generators are more easily controlled than munitions and will generate a more uniform coverage of a large area. If the generator is manufactured to create the right size particles, the aerosol can drift a good distance prior to dropping to the ground or evaporating. If the particles are too big, they fall to the ground too soon; conversely, if they are too small, the aerosol cloud disperses too quickly and is ineffective. Another limitation to aircraft delivered sprays is that the plane must operate slowly and in a straight line, which makes them vulnerable to enemy attack. The spray attack would be ideal for attacking poorly trained or unprepared personnel.

What CW agent to use in these delivery systems depends on what the target is and what effect is desired. Land mines are meant to deny terrain to maneuvering forces, so the persistent agents such as mustard and VX are chosen for the fills. With artillery projectiles, usually the attacker wants quick results, so lethal agents are chosen, such as hydrogen cyanide or sarin. The larger artillery projectiles (8 inch guns, 115 mm and 122 mm rockets) might use mustard, VX, or thickened GD to contaminate areas behind enemy forces, threatening their ability to resupply or reinforce a particular sector. Because aerial bombs and ballistic missiles often target the rear areas rather than the front lines, they will often be armed with persistent agents.

A quick note about ballistic missiles: the early Soviet and Iraqi Scud missiles were bulk-agent filled. This method is technically easy but inefficient in optimally covering large areas. When the U.S. Army developed guided missile warheads, they used agent-filled submunitions, where a few hundred bomblets in a warhead would come tumbling out and, at a certain altitude, crack open. This created a much more efficient dispersion pattern, covering a wider area of the target (but were more expensive than the bulk-agent filled warheads). This 1960s technology is certainly feasible for most nations to engineer today.

Those liquid agents that volatilize into gases present a vapor hazard in addition to a contact hazard, but the wind can spread this vapor hazard much farther than the area under attack. Weapons planners can calculate this downwind hazard, based on the number of chemical munitions and the CW agents they hold to effectively cover the intended target, and predict a certain percentage of casualties. If the targeted personnel are trained and have defensive equipment, the casualties will be low. If the personnel are untrained or lack equipment, the casualties will be

high. The weather is the final arbitrator in how effective a CW attack is. The wind speed is critical to effective coverage, making the difference between a puddle, a large hazard area, and a dust storm. Rain will affect the success of an attack (washing the liquids away), as will the heat of a summer sun (vaporizing the agent), or the depth of winter (freezing the agent). To a large degree, these variables have made chemical warfare less than popular with commanders expecting particular results every time.

Biological Warfare Agents

BW agents are not distinguished into generations, as are their cousins on the chemical side. Overwhelmingly, the currently most dangerous BW agents occur among the natural diseases found across the globe. While the former Soviet Union is believed to have researched "designer" BW agents or bioengineered agents, there is a great difference of opinion about whether these agents would work on the battlefield. Advances in biological technology may create the possibility of BW agents that are more potent and that are resistant to antibiotics and vaccines. Other people dismiss the threat, noting that engineered pathogens may struggle to survive or quickly lose their potency when released into a natural environment. By far, the natural diseases, culled out of nature using equipment that could be dual-use for pharmaceutical research (or even for brewing beer), seem to be the major military threat. BW agents have been developed for specific effects against humans, animals, plants, and even materials. They can be divided into pathogens, living organisms, and toxins, which are chemical by-products of biological organisms. As with CW agents, they can also be divided into the two classes of lethal and incapacitating agents.

There are thousands of biological organisms that have detrimental effects on people, but the list of agents that usually show up in a nation's offensive BW program is relatively short. The ideal BW agent should be hard to detect, consistent in its predicted effect on the target, possible to produce cheaply in mass quantities, able to be disseminated over a large area, stable while in storage and in transportation, and with a short and predictable incubation period. Ideally, the target population should have little to no immunity, whereas the using force should have its military and civilians inoculated (Dando 1994, 33). These require-

ments reduce the list to fewer than thirty or so prime candidates, which the CDC puts on a list as restricted agents to control their handling and transportation (OHS—Interstate Shipment of Etiologic Agents, accessed 2003).

We can break the pathogens down into classes of bacteria, viruses, rickettsia, and fungi. Bacteria are everywhere—in yogurt, in your stomach, in the air, in water, and in soil. They are complex, single-cell microorganisms that do not require living tissue to reproduce, and they are environmentally hardy. Rickettsia are rod-shaped bacteria that require a living host to reproduce. Viruses are much smaller microorganisms—not true cells, really just a small amount of genetic material carried in a protein shell. They require a living host to reproduce, are much more vulnerable to the environment, and are very selective about what hosts they harm as opposed to the hosts they merely infect. Fungi are organisms that superficially resemble plants but lack chlorophyll, thus requiring them to obtain nutrients from other living organisms. Nearly all BW pathogens come from the bacteria and virus categories.

Although it takes hundreds to thousands of bacteria to infect a person, it may take as few as one to ten viral organisms to infect that same person. Although bacterial infections can be combated with vaccines and antibiotics, viral infections often do not have specific vaccines or treatment therapies; all one can do is treat the victim's symptoms and wait for the virus to "burn out." On the other side, bacteria are often sturdier than viruses, which die off quickly in the natural environment if not incubating in a host. Although many pathogens will incapacitate a healthy individual, only a few pathogens have a high mortality rate. Most pathogens have an incubation time of days to a few weeks before the exposed individual shows symptoms. This time period means two important things: First, BW agents have a limited tactical use but have a good strategic value for softening up an adversary's military or civilian population in advance of military operations (or as a last-ditch weapon). Second, the BW detectors do not have to give an alarm within seconds of the agent's presence (as chemical alarms do), as long as there are medical countermeasures that can be used within a day or two.

One desired feature of anti-animal and anti-crop BW agents is that they can be weaponized against a specific cash crop or livestock of one's adversary, while ensuring that one's own crops and animals remain healthy. Some potential anti-plant BW agents include rice blight and corn blight (caused by bacteria), tobacco

mosaic, potato virus, and sugar beet curly top (viruses), and rice blast, rye stem rust, and wheat stem rust (caused by fungi). The U.S. Air Force stockpiled but did not weaponize rice blast, rye stem rust, and wheat stem rust. Anti-animal BW agents could include foot-and-mouth disease, glanders, psittacosis (against chickens), rinderpest (cattle plague), camel pox, and African swine fever. The U.S. military investigated but never stockpiled any anti-animal BW agents.

Of course, most of the interest in BW agents focuses on the anti-personnel agents. The lethal BW bacterial agents include inhalation anthrax, pneumonic plague, and tularemia. Lethal diseases caused by rickettsia include Rocky Mountain spotted fever and epidemic typhus. Untreated, these agents can cause high percentages of casualties, but none matches anthrax, with its short incubation period (one to five days) and almost certain lethality (more than 90 percent if untreated). Bubonic plague is the form of plague that devastated Europe in the medieval days, spread by the bites of fleas. The airborne variety, called pneumonic plague, can occur naturally as a secondary condition of bubonic plague and can be spread by victims exhaling the organisms. The pneumonic plague was weaponized by the Soviet Union and the United States. It requires two to three days of incubation, and it can also cause up to 35 percent mortality if untreated. Tularemia is not as lethal as these two, which makes it a prime learning agent for many countries starting out in this area. It is easily weaponized, and only ten to fifty particles are necessary to infect a human. Both tularemia and plague can be treated after symptoms appear. Not so anthrax. When anthrax patients show up at the hospital complaining of aches and pains, it is already too late. Anthrax and tularemia are not contagious, meaning there is no need for quarantine procedures, as is required with many viral infections.

The nonlethal BW bacterial agents include brucellosis, cholera, and dysentery. The one nonlethal BW rickettsia is *Coxiella burnetii*, also known as Q fever. All four can cause deaths in a small amount of cases if untreated, but in the majority of cases, these diseases just make the victim extremely sick for a few days to weeks. Brucellosis is another primer agent for early nations beginning an offensive BW program, for it is easily weaponized but not too lethal and requires anywhere from five to sixty days incubation before its effects are seen. Cholera and dysentery are

hard to weaponize, being water-borne diseases and not easily made airborne diseases, so often people refer to these as "potential" BW agents. Q fever is very infectious in low doses, can be transmitted by air, but is rarely lethal. It takes ten to forty days of incubation before any ill effects are seen.

The lethal BW viruses include smallpox and such viral hemorrhagic fevers as yellow fever, Lassa, Marburg, and Ebola. Although the last known naturally occurring case of smallpox was in Somalia in 1977, both the United States and the Soviet Union held on to smallpox stocks to ensure that they could make the vaccine if "someone" were to use the BW agent. Concerns that other nations could have produced their own stocks have surfaced lately, causing a scramble to stockpile the vaccine. Although smallpox is less than 30 percent lethal, it is highly contagious and leaves many scars on its survivors. The only gleam of light in this dark scenario is that victims are usually not infectious until just before and during the time that the scabs start showing (seven to ten days after exposure), thus warning other potential victims. Of the others, yellow fever is transmitted only by mosquitoes and has a fairly common vaccine, making it an unlikely (but still possible) BW candidate. The Soviet Union spent time investigating how to weaponize Marburg and Ebola viruses. As very infectious and lethal organisms, they could be potentially deadly if they could be transmitted by air instead of by aerosols or bodily fluids.

The nonlethal BW viruses include Venezuelan Equine Encephalitis (VEE), Western Equine Encephalitis (WEE), and Eastern Equine Encephalitis (EEE). These viruses can be transmitted by mosquitoes or by aerosol, are highly infectious, and are relatively inexpensive to acquire. VEE and WEE can cause chills, headaches, and high fevers for a few days but are rarely (less than 10 percent) lethal. EEE is the most lethal; it can cause up to 35 percent mortality, and some survivors suffer neurological deficits. Table 6.3 summarizes the major U.S. and Soviet BW programs, which look amazingly similar for having been developed by two adversarial nations not aware of the full extent of each other's capabilities.

Toxins, because they are complex chemicals derived from biological organisms, are not contagious and cannot reproduce. Because they are not themselves living organisms, some nations (such as Russia) do not recognize these as true BW agents but regard them as CW agents. The two most common toxins mentioned

TABLE 6.3
Major U.S. and Soviet Biological Warfare Agents

BW Agent	Type	U.S. Program	Soviet Program
Anthrax	Bacteria, lethal	Yes	Yes
Tularemia	Bacteria, lethal	Yes	Yes
Brucellosis	Bacteria, incapacitant	Yes	Yes
Venezuelan Equine Encephalitis (VEE)	Virus, incapacitant	Yes	Yes
Q Fever	Rickettsia, incapacitant	Yes	Yes
Botulinum Toxin	Toxin, lethal	Yes	Yes
Staphylococcus Enterotoxin Type B (SEB)	Toxin, incapacitant	Yes	No
Glanders	Bacteria, lethal	No	Yes
Plague	Bacteria, lethal	No	Yes
Smallpox	Virus, lethal	No	Yes

as military BW agents are staphylococcal enterotoxin type B (SEB), which is nonlethal, and botulinum toxin, which is lethal. SEB is very stable, has an extremely toxic reaction in low doses, and can be aerosolized easily. Botulinum toxin, more commonly known for its presence in spoiled foods, can also be aerosolized and acts quickly (within twelve to twenty-four hours) once inside a person's system. Gram for gram, toxins are much more deadly than any chemical or biological weapon, but because they cannot spread by infection or by evaporation, their utility on the battlefield is limited.

There are other toxins, such as the toxins from venomous creatures (snakes, frogs, puffer fish) and ricin toxin (from castor beans), but these are more appropriately viewed as assassination tools rather than BW agents meant for the battlefield. Aflatoxin, found in Iraq's arsenal, is a naturally occurring mycotoxin (mycotoxins are produced by fungi, especially molds). Before the Gulf War, intelligence analysts did not include this as a "threat" agent, since it is not lethal, but it is a known carcinogen. The Soviet Union was alleged to have employed a mycotoxin called T2 toxin, or trichothecene, in Laos and Afghanistan. This was the "yellow rain" aerosol that received so much attention in the 1980s. Some feel that the former Soviet Union abandoned this toxin as a failed experiment, having other more effective biological weapons in its arsenal.

Biological Weapon Delivery Systems

A successful BW attack relies on at least four elements: the BW agent, the munition being used, the weather, and the delivery. Far from the popular concept that "anyone" can develop BW agents in their bathtub, the art of developing BW agents and the munitions to deliver them is a carefully guarded secret. Even decades after the U.S. offensive BW program ended, little is published about how these weapons were developed or employed out of fear that other nations might pick up some tips. It is certainly true that if the local militia group wants to distill one gram of ricin out of a few bags of castor beans to attack a local citizen, they can do it. But manufacturing fifty kilograms of anthrax to take out a city is a major technical challenge. The key to weaponizing a BW agent is getting the BW agent to cluster in particles of the right size: particles of one to five microns. Less than one micron and the agent does not stay in a person's lungs. More than five microns and it drops to the ground and threatens no one. Between one and five microns, the small particles act almost like a gas, passing over terrain for miles and potentially exposing a large number of unsuspecting people.

BW agents can be developed in either a liquid slurry or a dry powder, depending on the agent. Although explosive projectiles are the favorite for chemical munitions, they will not work for BW agents, usually killing most of the agent as the burster opens up the munition. Liquid slurry in an explosive dissemination works slightly better but still gives a very low yield. The Soviet method to compensate for this low yield was just to use lots of munitions with big payloads. The United States' approach was to use gaseous energy, either from a nozzle or a rotor blade, to expel the agent from its projectiles or bomblets. This approach was far more efficient than explosive dissemination, but more technically demanding and more expensive.

The most efficient method of delivery is the spray generator, preferably under the wing of a high performance jet. Both the United States and Soviet Union developed spray generators, which, depending on the speed of the platform, the liquid's physical properties, and the stability of the agent, could get efficiencies between 30 percent and 75 percent. As with the CW agents, a long line source would increase the total area that could be covered. How much agent was needed depended on the BW

agent employed, but as long as it was a pathogen, the numbers were in the single digits: two to eight kilograms per square kilometer. For the toxins, it could take much more, upwards of 100 kilograms per square kilometer.

Secretary of Defense Bill Cohen, talking on television on November 17, 1997, about the threat of BW terrorism, held up a five-pound bag of sugar and commented that a similar amount of anthrax could wipe out Washington, DC. This was a slight exaggeration; it might take up to ten times that amount to effectively cover the city with a lethal dose of anthrax. Even then, less-than-ideal wind and weather could defeat the delivery. What the secretary was talking about was the lethal dose that would have to be carefully administered in minute quantities to every man, woman, and child in the city. Although his example was factual, he did not explain how the anthrax would be disseminated appropriately to get this highly efficient result. Remember that not all of the anthrax that is spread over a city would be inhaled or ingested; much of it would eventually fall onto the ground, roofs, and streets and be washed away or destroyed by the sun's ultraviolet rays. The point of this example is not to belittle the suggestion that five pounds of anthrax is dangerous (it is) but to point out that creating a truly effective mass casualty weapon does take a good-size quantity of agent and skillful dissemination.

The ideal line source system is a low-flying plane, and today's technology does not require a manned plane to conduct a long line source of BW agents. An unmanned aerial vehicle (UAV) or a cruise missile could be modified to spray its tanks in a straight line in front of enemy troops. In fact, this UAV or cruise missile could release its payload several miles from its target and still disperse an effective dose of BW agents, given the distance some can travel downwind (if the weather is right). There is the potential use of ground-mounted generators as well; during the 1991 Gulf War, there was a great deal of concern that Iraq had purchased agricultural sprayers from Italy and modified them for dispersing BW agents from a truck or small boat. Covert forces could carry backpack sprayers similar to those used for mosquito spraying and disseminate agent at night upwind of a target. It would not be as effective as an airplane-mounted sprayer, but it would produce the desired results.

All of these techniques are useless if the weather is not cooperating. On a sunny summer day, the winds would probably carry an agent release straight up and disperse it without causing

any casualties. A sunny day also has lots of UV radiation, which would start killing pathogen agents as soon as they are exposed, and wet weather would wash the agents away. The ideal conditions for releasing BW agents are in the early morning and late evening, or a day with overcast clouds. These "windows of opportunity" were key decision points for Air Force weapons planners when they targeted suspected Iraqi BW production and storage sites during the Persian Gulf Conflict.

As a final note, some people are concerned about nations' ability to covertly develop BW agents in laboratories or pharmaceutical factories, and others worry about the chance that some lone terrorist could create a BW agent in his cellar. Although in theory both these scenarios are feasible, the amount that can be made in such modest conditions is small, and creating the agent would be possible only if the manufacturers have the right equipment and education. And in the end, the weather and the method of dispersion may rule against the user, especially if a small amount is used. This last point cannot be overstated. A terrorist could use a small amount of BW agent within a building or enclosed area to cause a great deal of panic, but it would not cause a "mass casualty" threat.

Any military force using BW agents will require a good supply of bulk agent to have a sustained effect on the adversary's military operations. The U.S. production plant at Pine Bluff Arsenal had fermenters that could make almost a ton of anthrax each year, a ton and a half of tularemia, a ton of brucellosis, about two tons of SEB toxin, and less than a ton of botulinum toxin. The Soviet Union had six production facilities, and each one was larger than Pine Bluff Arsenal's production plant. According to William Patrick, a renowned expert in offensive BW programs and former U.S. BW weaponeer, Soviet plants could make 4,500 tons of anthrax each year, 1,500 tons of tularemia, 1,500 tons of plague, 100 tons of smallpox, and 250 tons of Marburg virus. That's a significant military capability.

Defenses against CB Weapons

Following World War I, General John Pershing, commanding general of the American Expeditionary Force, said, "Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly *to the unprepared* that we can never afford to

neglect the question" [emphasis added] (Heller 1984, 91). The fact is that CB warfare is a facet of combat operations that military personnel and antiterrorism professionals have to face. Because military forces are a pragmatic bunch, they examined the challenge of what is required to survive and sustain combat operations in a CB-contaminated environment, given the right doctrine, training, organizations, specialists, and equipment. Civilians may be unprepared and unprotected, and in the event of a military or terrorist attack using CB weapons, would no doubt die in large numbers.

There are a number of different perspectives on defending against the adversarial employment of CB weapons. It used to be that all one studied was how to protect against the threat of CB weapons use on the battlefield. This perspective has changed significantly, especially since a 5,000-pound bomb planted in a truck demolished the Khobar towers (near Dhahran, Saudi Arabia) in June 1996, killing nineteen U.S. military service members. Although terrorists' targeting U.S. military personnel is not a new phenomenon, the concept of force protection of military and civilian personnel at military installations has become increasingly important. The concept of force protection actually started before 1996. One can cite the bombing of the Marine Barracks in Beirut, Lebanon, in October 1983 as the real wakeup that military forces were being targeted off the battlefield. There's also the April 1986 bombing of a Berlin disco targeting American service members, the August 1998 bombing of U.S. embassies in Kenya and Tanzania, the *USS Cole* incident in Yemen in September 2000, and of course, the September 11, 2001, attack against the Pentagon.

Even though terrorists have not used chemical or biological warfare agents against military installations, there is increasing concern that given the tighter security measures against conventional terrorist weapons (handguns, knives, and explosives), they may turn to weapons that can be used at a distance from their target.

The issue of homeland security has been a popular theme for many talking heads since September 11, 2001. The anthrax-laden letters have shown a third form of CB warfare: attacking U.S. citizens and public institutions directly. Although the Department of Defense (DoD) has been focused on CB defense within the aspects of traditional warfighting and force protection, it has also been involved with homeland security, the protection of U.S. citizens and institutions from terrorist CB attacks, although not as the lead agency. Currently, the issue of CB defense within home-

land security has been seen as an issue for the Department of Health and Human Services (DHHS) and the Environmental Protection Agency (EPA), with the DoD playing a supporting role in any responses to terrorist CB incidents.

We will examine each of these three mission areas—traditional military combat, the protection of military installations, and homeland security—in turn. Although the same CB hazards present themselves in each area and common defensive equipment may be used across the three areas, the specific response within each area is unique and requires discussion to ensure that one does not make the mistake of assuming they require the same equipment and people.

The Traditional Warfight

In a traditional force-on-force combat scenario, military forces expect the possibility of CB warfare, given that deterrence efforts may fail and they are unable to destroy their adversary's storage sites and delivery systems. As a result, they are trained to look for early signs and symptoms of CB warfare agent exposure. They have specialized equipment to detect and identify the hazards, to communicate the warning across the battlefield, to protect themselves from exposure, and ultimately to clean up any persistent contamination. Before they are forced to use this equipment, however, there are other efforts taking place at the political and strategic level that can reduce the threat of CB warfare to military forces.

There have always been arms control efforts, but the resulting treaties never seemed to stop the steady proliferation of countries researching and developing CB warfare programs. For the majority of the twentieth century, the threat of CB warfare agents during wartime had one response: to retaliate in kind (or with heavier weapons), threatening to expose the enemy's forces to the same debilitating and harassing agents to which one's own force was exposed. This is what some call "classic deterrence." Following the Persian Gulf conflict, the U.S. military began a re-examination of strategy on how to deter, roll back, prevent, or reduce the threat of CB warfare. This was in a large measure because of the coalition's unsuccessful attempts to stop Iraqi mobile Scud launchers from firing ballistic missiles at their forces, missiles that had the potential to deliver CB warfare agents over a wide area.

Nonproliferation efforts are intended to influence countries into either giving up their CB weapons or not beginning an offensive CB warfare program in the first place. This includes the use of the full range of political, economic, or informational or military tools to prevent proliferation of nuclear, biological and chemical (NBC) weapons and missiles, reverse it diplomatically, or protect U.S. interests against an opponent armed with NBC weapons (DOD 1994). Most people associate nonproliferation with global arms control agreements and export controls to prevent the spread of technology and supplies to those nations that lack an inherent capability to produce these weapons. This includes inspections, monitoring, verification, and enforcement support for arms control treaties.

These efforts can also include attempting to persuade nations not to develop these weapons; denying the flow of materiel, technology, and expertise to nations seeking this capability; disarming nations that have the weapons with arms control efforts; and diplomatic pressure to punish those nations that proliferate the threat. Nonproliferation efforts include collecting and sharing intelligence with other nations, offering incentives or disincentives, and purchasing certain materials to prevent their transfer to potentially unfriendly nations (Schneider 1999, 47). For instance, in August 2002, the United States worked with Russia to move 100 pounds of highly enriched uranium from Yugoslavian nuclear reactors to Russia for disposal. The United States has also worked with the former Soviet Union states to clean up the former offensive CB weapons stockpile sites. There is a program to offer salaries to former Soviet Union weaponeers to keep them from selling their services to the highest bidders in countries trying to develop their own offensive CB warfare programs.

In the realm of CB warfare, the Geneva Protocol and Biological Weapons Convention (BWC) have no verification protocol; in fact, they were deliberately designed not to infringe on a nation's inherent rights of eminent domain. The Soviet Union's negotiators fought hard to prevent any uninvited inspections in the BWC's language, despite campaigns from the British and United States envoys to the contrary. The Australia Group similarly posts information on export controls but must rely on the nations to enforce them. The Chemical Weapons Convention (CWC), on the other hand, does have significant verification protocols in overseeing chemical weapons disposal and verifying that its signatories follow the rules. The Organization for the Prohibition of Chemical

Weapons (OPCW), an international group stationed in The Hague, executes this function. Although a nation can challenge one of the signatories on a specific suspected weapons production or storage site, this has never happened. Rather, the OPCW has exhibited a more passive role of routinely inspecting declared stockpiles and overseeing their destruction.

Defense Secretary Les Aspin led an initiative in 1993 to develop a counterproliferation policy, which was intended to prevent or reduce the threat that an adversary would use NBC weapons against the U.S. military. Counterproliferation efforts include those activities across the full range of U.S. government efforts to combat proliferation, including the use of military power to protect U.S. forces and interests; intelligence collection and analysis; and support to diplomacy, arms control, and export controls—with particular responsibility for assuring that U.S. forces and interests can be protected should they confront an adversary armed with NBC weapons (DOD 1996). Counterproliferation has been defined as the DoD's effort to limit NBC weapons, as opposed to nonproliferation efforts, which have a stronger political, diplomatic, and economic emphasis that is not limited to the DoD.

Counterproliferation involves defusing situations when nations may be tempted to use NBC weapons against their neighbors; deterring adversarial use through military, political, or economic threats of retaliation; destroying enemy production sites and weapon systems during times of conflict; and defending military forces against the delivery and dissemination of NBC weapons. This policy has, over the years, been crafted into a strategy that has four pillars: counterforce, active defense, passive defense, and consequence management.

Counterforce includes the ability to stop an adversary at any step of the production, transportation, or readying of a CB warfare weapon system before it is employed. This generally includes (but is not limited to) attacking production facilities, storage complexes, and deployed weapon delivery systems. During the Persian Gulf conflict, special operations forces and dedicated Air Force assets were searching for and destroying these targets to stop their potential employment against U.S. forces. Today, the U.S. Air Force is developing weapons under its Agent Defeat program to destroy, neutralize, immobilize, or deny an adversary access to their own weapons with little to no collateral damage. Other programs include the Hard Target Defeat effort, designed

to develop tools to penetrate and destroy hard and deeply buried targets that may be manufacturing or storing CB weapons.

Active defense measures are those taken to detect, divert, or destroy enemy NBC weapons and delivery means while en route to their targets—for instance, destroying theater ballistic missiles in flight, either with airborne platforms or by missile intercepts. These actions reduce the benefit that an adversary might expect to gain by the use of NBC weapons. One of the most visible efforts in this area is the Missile Defense Agency, formerly known as the Ballistic Missile Defense Organization. In addition to its efforts to develop a national missile defense system, the Missile Defense Agency has been researching and developing a capability to provide theater missile defense designed to protect deployed troops, allies, and civilians at risk from theater ballistic missiles. Another effort is the design of the Airborne Laser, a high-energy laser weapons system carried in a modified Boeing 747 plane. If successful, this laser could destroy or disable a ballistic missile hundreds of kilometers away. If the missile is caught in its boost stage, any debris or potential contamination could fall back on the nation that launched it.

Passive defense refers to defensive measures (rather than the offensive measures in counterforce and active defense) that enable forces to survive, fight, and win military operations despite the enemy's employment of NBC weapons or agents. If counterforce and active defense efforts were 100 percent accurate, there would be little need for passive defense. But since this is not the case, one needs to be prepared for those weapons that will get through counterforce and active defense measures. In the days before the creation of the term *counterproliferation*, this area was what one really referred to as NBC defense. These measures largely involve the use of materiel to protect forces against CB warfare agents, such as CB agent detectors, hazard prediction software, protective clothing and masks, medical CB defense countermeasures, collective protection systems in vehicles and in shelters, and decontaminants. Most combat forces do not like to use these measures because wearing protective clothing and masks, although protecting individuals against CB warfare agents, slows down the tempo of a military force and makes it more vulnerable to conventional weapon systems. The better trained the force is in using this gear, however, the less degraded their operations are when they are forced to use passive defense equipment under combat conditions.

Consequence management refers to the essential services and activities required to manage or reduce damages or other consequences or problems resulting from the employment of NBC weapons. In general, this means cleaning up after the incident so one can return to an unprotected status. These measures include the long-term actions required to mitigate the effects of NBC weapons resulting from combat operations. Such measures are usually conducted after hostilities die down and dedicated specialists can be brought in to work. During a military conflict, consequence management can also mean the measures that U.S. military would use to respond to a host nation that may have suffered a CB weapons attack from an adversary, either nation-state or terrorist. This is referred to as foreign consequence management.

As one can see, the four measures of counterproliferation are sequential. Ideally, one would like to destroy the adversary's CB weapons production and storage capability before any weapons are readied for use. If the weapon systems have already been deployed, one would want to intercept the weapon systems while they are being moved to the front or when the aircraft or missiles are in the air, before they come into range of friendly forces. Failing that, the friendly forces should have measures to find out where the CB warfare agents are, equipment and training to protect themselves from CB warfare effects, and capabilities to reduce the contamination effects so they can carry out their mission. Finally, long-term restoration efforts will return the contaminated area to its former pristine state.

Protecting Military Installations

Since 1983 (the year of the Marine Corps barracks bombing in Beirut, Lebanon), there has been a concern that hostile military forces will try to attack U.S. military bases with CB weapons prior to the formal announcement of hostilities. Because the United States relies on a relatively small number of military bases to project its force overseas, the potential results of CB weapons contamination on these bases could, at best, delay the projection of these forces, giving a critical advantage to the enemy. At worse, such an attack could injure or kill many DoD civilians or military dependents. The effects of such an attack against an overseas military base could similarly create a fatal delay, degrading military operations at the onset of a conflict or when reinforcements were

meant to arrive. In a similar fashion, terrorists could attack military bases with CB warfare agents, which might cause only a few casualties but would cause mass panic across the nation. Although the terrorists would employ much smaller amounts of CB warfare agents than a foreign military power could, the attack could still cause a critical delay in getting forces into action, or at the least, score an international coup against the U.S. government.

The threat of terrorist CB incidents is a somewhat recent concern, however. Military leaders assumed that most (if not all) domestic terrorists would aim their efforts at private organizations or local, state, or federal government offices rather than at military installations. As one might imagine, this viewpoint has changed since September 11, 2001. The threat of CB warfare agents is a particular challenge to those who assumed they could stop all threats at the installation's gates. CB warfare agents, particularly those designed to be aerosolized, could be released a mile from the base, and, weather permitting, cross the installation's boundary and affect personnel on the base. It might take a considerable amount of agent to actually cause a significant impact, which leads to the second scenario: a terrorist who smuggles a small canister of CB warfare agent in a fire extinguisher into an installation, for instance. The target might be a particular headquarters building rather than the entire base. There are many challenges to developing enough agent to affect a large base; some theorists postulate that terrorists could just hijack a tanker of industrial phosgene and crash that into the front gates. But, although that would cause a significant impact, the liquid would evaporate quickly, and at least firefighters know how to deal with a hazardous chemical material; they may not be as familiar with handling military-grade CB warfare agents.

All installation commanders have the responsibility to assess their bases' vulnerabilities and to prepare against the potential consequences of a terrorist incident, including preparing for the possibility of a CB terrorist incident. The DoD calls for a force protection plan to be developed at all U.S. military installations (DOD 1999). Force protection plans are designed to protect military service members, civilian employees, family members, and facilities and equipment in all locations and situations. They are accomplished through the planned and integrated application of efforts to combat terrorism, to provide physical and operational security, and to provide personal protective services. These efforts are supported by intelligence, counterintelligence, and other se-

curity programs (DOD 2001). There are several components to force protection: antiterrorism, physical security, and consequence management are the major ones. There is a great deal of focus on maintaining perimeter security and on responding to incidents; thus, there is a heavy emphasis on police forces, explosives ordnance disposal (EOD), firefighters, and emergency medical technicians, just as there would be for any city. All military bases do not have the same level of preparedness. Large bases with critical functions will be more heavily protected than most small bases that do not have significant resources.

The focus of force protection is on saving lives prior to and during a terrorist incident while maintaining critical operations. Antiterrorism measures are intended to make it more difficult for terrorists, criminals, or vandals to penetrate the installation and cause damage. To counter terrorist CB incidents, installations might need special detectors, protective suits and masks, shelters, and decontamination equipment similar to those of a military unit. The DoD can train emergency responders and military specialists on a base to respond to a terrorist CB incident. These specialists can prevent the spread of contamination that might cause additional casualties in the near term and to initiate the steps required to restore base operations. Most installations do not have substantial resources or staffing to address major incidents that might include the use of military-grade CB warfare agents. To return the installation to its previous pre-incident state, it may be required to call in off-post consequence management specialists, similar to the process discussed previously in counterproliferation.

The real challenge is that, although the U.S. military understands how to protect its forces from CB warfare agents on the battlefield, protecting civilians at military installations and facilities is an entirely different situation. First, it is very costly. There are more than 600 DoD bases that could require sophisticated detectors and hazard prediction software, there are tens of thousands of buildings that could require collective protection shelters, and the response forces on the bases need their own special detectors, protective gear, and decontaminants to survive hazardous conditions. There are more than 2 million civilians living or working on military installations who could require some kind of protective masks and clothing or protective shelter material for their houses and offices, much like the Israeli citizens had during the Persian Gulf conflict when they feared Iraqi Scuds might carry CB warfare agents.

Second, how does one train all these civilians and keep them prepared for such an incident without overdoing the paranoia? People argue that preparedness for a terrorist CB incident must be maintained at all times, whereas a terrorist has to be lucky only once. Although the actual number of casualties from a terrorist-employed CB weapon might be small, the psychological impact would be significant. Take the Pentagon's issuing of escape masks in March 2003 to all of its workers and the establishment of cabinets holding escape masks for visitors, for instance. These masks will probably (one hopes) never be used, yet the Pentagon leadership felt motivated to provide its workers with the assurance that there was a plan. This capability will not be instituted at all DoD installations and facilities because it is costly to train personnel and maintain this capability, and the real focus and energy (to be honest) should be on stopping terrorists armed with explosives and handguns.

Third, if a focused CB defense effort were to be implemented on all military bases, it could divert specialists and equipment from military operations overseas. Although one can make the argument that unprotected military bases are more vulnerable than protected ones, they are not likely targets for terrorist CB hazard attacks. Military units, on the other hand, recognize that they *are* likely targets of CB weapons when they enter combat operations against nations and terrorists armed with these weapons. The question is one of balance: how much effort should be put toward preparing military forces for CB warfare and how much effort should be put toward preparing installations to respond to terrorist CB incidents? The equipment and expertise for both come from largely the same pool of resources, and this pool is not very big. Rough estimates of the cost of providing such protection to 530 DoD installations exceed \$3 billion to establish a minimal protective capability (let alone a robust capability), and those estimates do not include manpower costs or the annual costs of sustaining that capability throughout the year. In comparison, the DoD plans to spend about \$1.5 billion a year on developing CB defense capabilities for military units between 2006 and 2011. This does not include equipment for those military installations.

The key to developing CB defenses on military installations and at government facilities lies in a successful assessment of threat and vulnerability; prioritizing the likelihood of a terrorist CB incident against other, more likely threats; and purchasing military and commercial CB defense equipment in amounts that

allow for a sustained capability throughout the year. This may mean that only those personnel critical to the base's operation and the top leadership get full protective equipment, while the majority of civilians receive instructions on shelter-in-place and evacuation procedures. Instead of a network of detectors, perhaps only the military police and firefighters have detectors and protective suits. And instead of preparing huge stockpiles of decontaminants and medical stockpiles, the installation commander may need to rely on outside agencies to restore and recover from a terrorist CB incident.

Homeland Security

Homeland security is not a new issue; the military has been involved in protecting the U.S. homeland since at least 1941, although the threat at that time was Soviet bombers and missiles, not terrorists. The U.S. government and various think-tanks had been considering the issue of protecting the U.S. people and the nation's facilities from terrorist CB attacks since at least 1995. Actual measurable efforts to improve local civilian responder capabilities in the event of terrorist CB incidents were limited prior to the attack on the World Trade Center and the Pentagon, however. The four anthrax-laced letters sent in October 2001 spurred an extreme focus on the potential effects of biological terrorism; although chemical terrorism is still a concern, many analysts feel that an unannounced BW attack against a major metropolitan city would be devastating. By the time the first cases of a contagious disease are identified, the organism could already have impacted thousands, and it could be spreading to other cities. A number of studies have been done on the possibility of a terrorist attack using smallpox, studies that are driving the recent preparations to build a national smallpox vaccine stockpile.

President George W. Bush defines homeland security in his national strategy as "a concerted national effort to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks that do occur" (White House 2002). When we discuss the issue of homeland security and the particular threat of terrorist CB incidents, it should be understood that there are at least three distinct areas: First, there is the issue of defending the United States and its critical infrastructure (to include military bases)

from external attack, including attacking those enemies overseas. This is homeland defense. Second, there is DoD's active support of the Department of Homeland Security (DHS), Department of Justice (DoJ), and other government agencies in any federal responses to domestic terrorist CB incidents, which is called civil support. Third, there are those national strategies and capabilities developed by DHS and other government agencies (often with DoD collaboration) to address terrorist CB incidents. This is called emergency preparedness.

Homeland defense addresses the protection of U.S. sovereignty, territory, domestic population, and critical defense infrastructure against external threats and aggression (DOD 2005). This includes the use of the armed forces to deter and defeat direct attacks against the United States, primarily through constant surveillance of the air (by the Air Force and North American Aerospace Defense Command) and sea approaches (by the Navy and Coast Guard) which might be used by adversaries. Ground forces maintain the ability to respond rapidly against any threats to DoD personnel, defense critical infrastructure, or other domestic targets. Although there are limited U.S. military forces working with the Border Patrol, the question has arisen as to the need for an increased military role in guarding the land border. The protection of military installations falls under homeland defense, which was previously discussed.

Defense support to civil authorities, or civil support, includes military assistance to U.S. civil authorities for domestic emergencies and for designated law enforcement and other activities. The DoD is not the lead agency in combating domestic terrorism or responding to terrorist incidents, but it does have specialized CB defense capabilities that can be called upon to support consequence management efforts. In most circumstances, this means deploying specialized military units in the support of federal response to state and local agencies' requests for assistance in the response to a CB terrorism incident. The military has already been active in this area: both the U.S. Army 20th Support Command (CBRNE), stationed at Aberdeen Proving Ground, Maryland, and the U.S. Marine Corps Chemical-Biological Incident Response Force (CBIRF), stationed at Indian Head, Maryland, are practiced in responding to civil requests for federal assistance in responding to terrorist CB incidents. The National Guard WMD Civil Support Teams were developed to provide the states with a rapid response force that could advise the local and state emergency responders

while federal forces were on their way. There are also Army Reserve chemical reconnaissance and decontamination units that may be deployed in response to a CB incident. The DoD's new command, U.S. Northern Command, assumes responsibility for coordinating this function.

The role of DHS, DoJ, DHHS, and other government agencies in protecting the nation from terrorist CB incidents is both complex and complicated. The main guide addressing the responsibilities of federal agencies to respond to incidents of national significance is the National Response Plan (DHS 2004). This plan identifies DHHS as the lead federal agency to develop medical capabilities that address the threat of bioterrorism; the EPA has the responsibility to address hazardous material spills, to include chemical contamination caused by a terrorist attack. The DoJ has the lead to deploy federal resources and direct actions during an actual or potential terrorist incident, while DHS has the lead to respond to and assist in the recovery from terrorist attacks. In all cases, the state and local government agencies are expected to be the first to be on the scene after an incident occurs and to request federal assistance before their resources and capabilities are overwhelmed.

Because the federal government views the threat of bioterrorism as particularly dangerous to the United States, the Bush administration developed a distinct national effort to address that threat (White House 2004). This included the development of specific programs: BioWatch, a network of air samplers deployed around thirty metropolitan areas to detect the release of BW agents; BioShield, a program to speed the development and acquisition of new medical countermeasures against terrorist CBRN hazards; and BioSurveillance, a medical surveillance effort to network CDC national laboratories with state and local hospitals and identify signs of an epidemic or unnatural disease. In addition, the federal government has taken steps to develop a national stockpile of smallpox and anthrax vaccine (and other medical products developed to treat chemical and radiological hazards) to be used in support of any terrorist incident and to initiate a program to address the possibility of BW attacks against U.S. agriculture and food.

The question is, does the nation need a national vaccine stockpile? The smallpox virus would be very hard to get; it is no longer found naturally, and samples are known to exist in only two nations: Russia and the United States. The side effects of this

vaccine are worse than those associated with the anthrax vaccine, which has received much undeserved notoriety. For every million people receiving the smallpox vaccine, fifteen will suffer major complications and one or two will die. A larger group will suffer side effects that are serious but not life threatening, such as blindness or skin ailments. Many will suffer from fevers or malaise. Although these side effects are in part because some of the population are people who would have an increased sensitivity to any vaccines (the old, the sick, and the very young), there is the possibility that these victims and their families would blame the government. The cost of a national vaccine stockpile will be in the billions; currently, the government is storing only smallpox and anthrax vaccines, but certainly there are many other dangerous BW agents that might be used by terrorists. However, after 9/11, it was felt that "something" had to be done to prepare for the possibility of a mass casualty event caused by a lethal BW agent.

The BioWatch program is similarly criticized, as the network of air samplers is limited to a set number of specific cities; the air samplers would catch a BW agent only if it were aerosolized over a large area; and the time to detection is still more than twenty-four to forty-eight hours, at best. Many critics believe that the more logical and cost-efficient medical effort would be to improve the overall public health infrastructure so as to decrease the time to diagnose and begin treatments after a BW incident. It might be beneficial to connect military laboratories and hospitals to the civilian health infrastructure to improve communications of early diagnoses and treatments of any contagious disease outbreaks.

There is considerable overlap in the areas of force protection and homeland security; the main difference is in what specific population is being protected. In force protection, installation commanders are protecting their own personnel and dependents on a base. There are limited funds for this task, but there are clear guidelines, and the installation commanders can craft the response according to their scope of authority, the perceived threat and their vulnerability, and limited resources. In homeland security, the DoD is supporting other federal agencies to protect U.S. citizens and civil infrastructure. The military is not in charge of funding or leading the response; instead, it defers to federal, state, and local civilian authorities. The funding strategies, degrees of risk, and political actors for homeland security are different from those for military combat operations. There are, how-

ever, similar defensive responses that can be adopted in any examination of the CB warfare threat in military operations, force protection, or homeland security.

Focusing on the Response

The U.S. Army Chemical School, as the DoD's executive agent for CB defense, leads the development of doctrine, organization, training, leader development, and materiel solutions for CB defense challenges. The Army is also the only branch that dedicates full-time specialists to addressing CB warfare. The Air Force and Navy include CB defense training for its disaster preparedness and counterproliferation officers. The Marine Corps does have CB specialists but not CB defense units (outside of the CBIRF). As a result, the Army often leads the DoD in developing the capability for a joint service response to CB warfare agents.

In 1999, the Chemical School developed a concept known as *sense, shape, shield, and sustain*, which emphasizes the need to *sense* CB hazards through reconnaissance, detection, identification, diagnosis, and surveillance; to *shape* the commanders' picture of the battle with timely information on the presence or absence of CB hazards; to *shield* the force from CB hazards through individual and mobile collective protection measures; and to *sustain* the force through fixed collective protection, decontamination, and medical restoration efforts. These principles can be executed simultaneously, with some of the force sensing the hazard while others sustain the force in collective protection shelters. Others in "clean" areas (determined from information gathered from networked sensors) do not have to shield themselves with hot and bulky protective suits and masks. These principles can apply equally in the discussion of military operations, force protection, and homeland security. Although the discussion in this book focuses on the U.S. military's approach to CB defense, nearly all countries with a CB defense program address the threat this way.

The capability to *sense* CB hazards generally requires specialized personnel and equipment to provide critical information to warfighters, civilians, or other federal agencies (depending on the mission). There are three general areas within this broad area: the ability to provide early warning with sensors prior to the arrival of the hazard; the ability to employ automatic point sensors

in the immediate area to warn personnel of the presence of CB warfare agents; and medical surveillance that supports the identification of actual exposure of personnel to CB hazards. There are distinct differences in sensing for chemical rather than biological warfare agents, in large part because chemicals stand out as unnatural elements whereas biological organisms are hard to distinguish in an outdoor environment.

With early warning, one can detect and in some cases identify CB warfare agents through stand-off detectors using infrared or ultraviolet lasers to detect agents kilometers away, through remote point detectors set at a distance from personnel and networked into a command post, or through reconnaissance provided by mobile specialists actively searching for areas of CB contamination. This capability provides what is termed "detect to warn": forces can physically avoid the contamination, take shelter, or mask prior to the arrival of the hazard. Early warning capabilities come at a steep price. They require specialized and often very expensive equipment and qualified operators trained to employ and maintain this equipment. Reconnaissance vehicles cost between \$1 million and \$2 million each, for instance. The Army and Marine Corps have a specialized NBC reconnaissance vehicle with dedicated operators: the M93A1 NBC Recon System, or "Fox" vehicle. This is a German Fuchs light-armored vehicle that holds three to four soldiers who operate point and stand-off systems from within the collectively protected vehicle. A newer NBC recon system, using the Canadian Light Armored Vehicle (LAV) chassis, is currently being fielded to U.S. forces.

As of 2005, there is only one fielded military chemical agent stand-off system, the M21 Remote Sensing Chemical Agent Alarm. This uses a passive infrared sensor to detect aerosol clouds at a distance of up to five kilometers.

Developing BW agent stand-off detectors has been difficult because at a distance, it is hard to discriminate man-made BW agents from common biological organisms in the environment. The U.S. military is close to fielding a limited number of stand-off systems that will discriminate man-made biological organisms from natural ones in the environment, but not positively identify them. Generally, military forces have comparatively few early warning devices and reconnaissance vehicles (due to their cost and the need for specialists to operate them), but they can scan large tracts of the battlefield very quickly.

Automatic point detectors are usually built to be fielded in large numbers. They cost much less than early warning devices and can be operated by nonspecialists with minimal training. At least, this is the ultimate goal. Some CW agent point detectors have been built small enough to carry in one hand and are sensitive enough to give an alarm at less-than-lethal levels. There is a good deal of concern about the potential for false positives, that is, cases where the detectors give an alarm although nothing is present. False positives can occur because the devices are set to be so sensitive that interferents (such as pesticides or diesel products) can set off the alarms. If the device was not so sensitive, there might not be any false positives, but the current trend has been to focus on achieving more sensitivity instead of decreasing the number of false alarms. What one does not want at all are false negatives, that is, when the detectors do not alarm even though the CB warfare agent is present. Some false positives are acceptable, given the ability to double check with other detectors, but no false negatives can be tolerated, for that means people are being exposed without being warned.

There are a number of different chemical point detectors, largely because of the desire to develop tools for different purposes and different missions. For continuous and automatic detection and warning, there are the M8A1 chemical detectors (which detects nerve agents only) and the newer M22 chemical detectors (which detect nerve and mustard agents). These devices are intended to sound an alarm at levels that will permit people to mask before being exposed to lethal levels of agent. The trend is to design future detectors to be more lightweight and portable; the next generation detector, the Joint Chemical Agent Detector is as small as forty-two cubic inches and weighs as little as two pounds in weight. Finally, there is the M1 Chemical Agent Monitor, which is used to verify manually the presence or absence of agent on equipment after decontamination operations are completed.

Again, it is more difficult to build biological point detectors. Automatic BW agent detectors are large and much more expensive, given the desire to be absolutely sure of finding any BW agent present and to minimize the time from trigger to taking action. Current BW agent detectors do not identify agents quickly because they have to sift volumes of air and be triggered by potential BW agents prior to identifying them and giving the alarm

to an actual threat. The time from triggering to alarm can be anywhere from fifteen to forty-five minutes after an attack, which means they cannot warn a person to mask or take shelter. This time delay has given rise to the phrase "detect to treat," as opposed to "detect to warn": all the device tells you is that you have been exposed and must now seek medical attention.

The Army has military units composed of Biological Integrated Detection Systems, which use the Joint Biological Point Detection System to allow for the mobile surveillance for BW agents. There are fixed-site biological detection systems called Joint Portal Shields at U.S. military installations in southwest Asia and northeast Asia, built on similar technology. These systems all operate on similar "wet chemistry" technologies. They constantly sample the air until a large biological presence is detected, triggering the system to take a sample that is deposited in a liquid. This sample is tested on antibody-antigen-detector assays. If there is a positive identification, the operator alerts the command. Since BW agents take much more time to affect personnel (from two to ten days), this time lapse is not critical as it would be with CW agents, which can kill exposed personnel in minutes or seconds.

Medical surveillance relies on the fact that humans are ultimately the detection device for any CB warfare agents that are not detected by early warning or point detectors. Because medical personnel monitor the health of any deploying force or civilians on a base, they will note any outbreaks of disease or patterns of exposure that match the signs and symptoms of CB warfare agent exposure. They also monitor what is known as disease nonbattle injuries, which can be an indication of an undetected biological agent attack. One difficulty in this process is that medically trained personnel can be hard to retain in the military; there are never enough medical personnel to watch over everyone. Medical personnel also require field laboratories or backup capabilities if they are to analyze clinical and environmental samples to diagnose and treat CB warfare casualties. In addition, the military must transport samples of the BW agent back to U.S. and U.K. laboratories for confirmation that this was an intentional use of a military BW agent and not just a natural outbreak of a local disease.

The capability to *shape* CB hazard information requires the integration of CB warfare sensors across the operating environment with command and control software to provide near-real

time data to warfighters, commanders, civilians, and other federal agencies. This capability does not focus merely on CB hazard information; it must also integrate medical data, logistics data, and meteorological and terrain data to project a full picture of CB defense readiness. In addition to networking the CB warfare sensors, one must have some kind of hazard prediction software to analyze potential operational scenarios and to predict where the hazard could be, in addition to mapping where the sensors have reported contamination.

The two hazard prediction software packages adopted by the U.S. military include Hazard Prediction and Assessment Capability (HPAC) and Vapor, Liquid, and Solid Tracking Model (VLSTRACK). The Defense Threat Reduction Agency developed and maintains HPAC, giving it to military and defense agencies that need to model CB warfare effects. Through HPAC, a skilled operator can predict the effects of hazardous material releases into the atmosphere and their impact on civilian and military populations. It models CB warfare releases resulting from conventional weapon strikes against enemy CB warfare production and storage facilities or from accidental releases, and it models the downwind hazard areas of such releases. VLSTRACK was developed by the Navy as an operational model and simulation tool, providing downwind hazard predictions for a wide range of CB agents and munitions. It can take into account weather and terrain effects, high altitude releases, and other variables. These models do not run quickly; the amount of data required can be staggering, including the exact type and number of munitions, agent purity, height of burst, wind speed and direction at different altitudes, 3-D terrain reliefs, temperature data, and so on. It takes even experienced operators hours to run some iterations, and even then there are disagreements over the results.

Consider the Khamisiyah bunker demolition in 1991. When DoD and the CIA asked their modelers to estimate the downwind hazard area using a very low level of nerve agent, the resulting pattern looked like two rabbit ears splitting away from a central source. (Office of the Special Assistant for Gulf War Illnesses 2000) Neither model was "wrong"; they just ran differently based on their respective methodologies. There are a number of other CB warfare agent models: CALPUFF, D2PC, D2-PUFF, MIDAS, NUSSE4, PEGEM, SCIPUFF, and many others, if one includes the hazardous material models. The challenge is validating and verifying that the models will accurately tell the

operator how the CB warfare cloud will actually move in real situations. Because the U.S. government does not permit open air CB warfare testing any more, it is nearly impossible to verify that these models actually perform as advertised. We think the models are accurate, based on particle physics, but there is nothing like the real thing to prove out the model. The DOD is creating a new modeling system called Joint Effects Model, which will incorporate the features of both VLSTRACK and HPAC and add many new features to the software.

Many military forces, emergency centers, and hazardous materiel units have predictive software that can assist in estimating where the contamination is. The problem has been how to connect all the sensors to the command, communications, control, computers, and information (C4I) system. Each military branch in the U.S. military has a distinct C4I system, and these do not always talk to each other. A similar lack of interoperable communications is often seen between firefighters and police in the same city, for instance. However, steps are being made to standardize the C4I systems. The potential benefits of networked sensors providing instantaneous data to the commanders is an intoxicating idea, as this capability could literally allow many individuals to take actions preventing or limiting their exposure to these CB warfare agents. On the other hand, one has to be concerned with the possibility of false alarms, which may spook the force instead of protect it.

In the meantime, there is always the manual method of data collection and analysis: military personnel have a standard NBC warning and reporting format to report CB warfare alarms and indications. These data are relayed to higher commands, analyzed, and disseminated to whoever needs the information. This system worked well in the Persian Gulf conflict to follow up and investigate potential CB warfare attacks that later were discovered to be false alarms. During Operation Iraqi Freedom, a more sophisticated hazard prediction model called Joint Warning and Reporting Network combined HPAC and VLSTRACK together, but was not directly linked to the automatic CB point and stand-off sensors. That remains a future goal.

The capability to *shield* personnel from CB hazards requires an integration of manual detectors and monitors, protective suits and masks, individual decontamination kits, and medical pre-treatments and vaccines. The capability to shield major weapon systems such as tanks, aircraft, and ships from contamination re-

quires the addition of collective protection equipment (filters and overpressure systems) and the use of barrier materiel (plastic sheets) to cover critical equipment. In general, the military has invested considerable time and money into shielding its personnel and equipment from CB hazards.

The most obvious example of this is protective suits and masks. The older protective suit for the military was the Battle-dress Overgarment, or BDO, which could be worn for up to thirty days and still provide protection. This suit is being replaced by the Joint Service Lightweight Integrated Suit Technology, or JSLIST, ensemble. This semi-permeable protective suit can be worn for up to forty-five days without loss of ability to protect the individual from vapor or liquid contact with the skin. It is designed and tested to protect the wearer from up to ten grams of liquid nerve agent per square meter of cloth for up to twenty-four hours of protection. This level of contamination is roughly equivalent to standing directly under a plane or artillery shell that is dispensing liquid CW agents. Butyl rubber boots and gloves also make up important parts of the ensemble. This ensemble is not used by civilian hazardous materiel handlers, however; emergency responders answering a CB terrorist incident must obey more stringent occupational safety regulations. This is not to say that military personnel are not safe: they are safe for short duration attacks, and the protective suit and mask do not overly interfere with their ability to execute a mission.

The new protective masks have improved vision and breathing resistance compared to those available during the Cold War, and they can filter out all chemical vapors, biological organisms, or radiological particles. The M40- and M42-series protective masks are worn by the Army and Marine Corps; the Air Force and Navy use the older MCU-2A/P mask for their ground forces. Aviators have special requirements for their masks, given the interfaces they have with their aircrafts (both for electronics and oxygen) and the need to keep their vision completely unobstructed. Apache pilots need the M45 mask, which interfaces with their unique targeting systems, and fixed wing pilots use their CB Respiratory Mask (Navy) or Aircrew Eye/Respiratory Protection mask (Air Force) with their flight ensembles and specific airframes. By the year 2010, the DoD plans to modernize their protective masks by moving to one general mask for all military personnel on the ground and two aviator masks, one for all rotary wing pilots and one for all fixed wing pilots. The masks for

ground personnel are "negative pressure" masks, meaning they filter the ambient air and are not supplied with oxygen from a tank, as firefighter self-contained breathing apparatuses are.

Military personnel can carry a number of inexpensive, manual detector kits and monitors to identify the hazards in their immediate area, allowing them to confirm whether it is safe to unmask and take off their protective clothing, or to take immediate life-saving measures in the event that they are exposed to lethal hazards. They carry detector paper for liquid and aerosol CW agents and manual kits and monitors for sampling for low levels of CW vapors. This includes M8 detection paper (very much like litmus paper), M9 detection paper (which has a sticky back so it can adhere to surfaces), and an M256A1 chemical detector kit, which is more sensitive than the automated detectors. There are hand-held bioassay tickets to sample for the presence of BW agents. Radiation monitors called dosimeters have been around for decades and continue to be part of the individual's protection package. Service members also carry individual decontamination kits, which are hand-sized pads composed of a dry resin that can absorb liquid agent that may have been deposited on their body or personal equipment. The current U.S. military version is called the M291 skin decontamination kit, and there is also a larger M295 hand-sized individual equipment decontamination kit.

Medical pre-treatments provide additional protection, and medical prophylaxes support those individuals who do not get their suits or masks on in time. Examples of medical pre-treatments are anthrax and smallpox vaccine; on the chemical side, pyridostigmine bromide tablets assist in blocking nerve agents from affecting one's nervous system. Medical prophylaxes include atropine and 2-PAM chloride for countering exposure to nerve agents, and the antibiotics ciprofloxacin and doxycycline to counteract bacterial BW agents. There are no treatments for viral agents; about the best one can do is get medical treatment for the symptoms and ride the virus out. The challenge with medical countermeasures is to get these drugs approved by the FDA, which demands that both efficacy and safety be proven for all military items used on the body. As a result, several biological vaccines are at least a decade away from being ready for use.

For vehicles, vans, and ships, there are two main forms of protection. One is the use of collective protection systems. Tanks, armored personnel carriers, ships, and some trucks have filtered ventilation systems to which personnel can hook their masks, re-

lieving some breathing resistance and cooling the person down. In addition, the interior of some armored vehicles can be kept at above-atmospheric pressure to keep aerosols and vapors out. These filters are much larger than the ones found on masks, for they have to channel up to hundreds of liters of air per minute. There are also equipment design features that can reduce the possibility of CB warfare agents running into areas that cannot be decontaminated (cracks, crevices), and there are materials that survive the corrosive effects of CB contamination and the decontaminants used to clean the equipment.

As forces become contaminated, they lose momentum because of the need to wear protective suits and masks. Operational decontamination amounts to spraying high-pressure hot water on the vehicles to remove most of the contamination, reducing the hazard to the crew. In general, military forces will execute operational decontamination operations with light decontamination applicators that they can carry with their maneuver forces and use as required. The U.S. military standard is the M17A1 Lightweight Decontamination System, which is being replaced by a Multi-Purpose Decontamination System.

Last, there is the capability to *sustain* operating forces and installations during CB warfare attacks or terrorist CB incidents, allowing them to operate for extended periods despite the hazards of CB agent contamination. These measures include fixed site and temporary collective protection shelters, thorough decontamination operations, medical diagnosis and treatments, and logistics support. Most military forces have a high "tail-to-tooth" ratio, meaning they rely on a large number of combat support forces at air bases, seaports, medical facilities, command and control nodes, and logistics sites to keep the combat forces supplied and engaged. If the rear area goes down, so does the chance for victory.

The first measures to protect these rear area fixed sites include the use of temporary collective protection shelters and collective protection systems installed in buildings. If the personnel at a fixed site can operate freely within these shelters despite the presence of contamination outside, then military operations can continue. These shelters use plastic liners, air locks, large filters, and powered generators to maintain a clean environment. One drawback is that they can be difficult to set up quickly and thus must be installed prior to any attacks. The other drawback is that there really are not that many shelters outside of those used by medical field hospitals. Because of the size and power requirements and cost of

these shelters, and perhaps because of the difficulty of integrating this protection into current military shelters, most military forces tend to rely on individual protective equipment rather than on shelters.

Thorough decontamination requires specialists with heavy, powered applicators and decontaminants developed to neutralize or remove the CB warfare agents in order to allow the crew to resume unprotected operations. The Army's decontamination companies set up thorough decontamination sites using the M12A1 Power-Driven Decontamination Apparatus, a veteran from the Korean Conflict that is being replaced in the next few years. Operators drive their contaminated vehicles to the sites, where the vehicles are then decontaminated to a level at which they can be operated without requiring the use of protective clothing and masks. This process is very demanding in terms of time and supplies, requiring thousands of gallons of water and clean protective clothing to replace the contaminated ones carried in by the troops.

Past military decontaminants such as super-tropical bleach (STB) and DS-2 are very corrosive and not great for the environment, but they work very well in destroying CB warfare agents. The military is in the process of developing replacements for these decontaminants. It is particularly challenging to find a decontaminant that does not destroy sensitive equipment such as optics and avionics. Ideally, one would want a decontaminant to be easily applied, to act quickly to neutralize or remove the contamination completely, and not to have harmful effects on people, equipment, or the environment. Decontaminants should also be inexpensive (as tens of thousands of gallons may be needed for military decontamination operations), produce no toxic end products, and be stable for long storage periods. Commercial decontaminants include high-test hypochlorite (HTH) bleach and Fuller's earth (a clay-like substance), which work well, but not as well as DS-2 in some cases.

Medical diagnoses and treatments allow military forces to rapidly assess their exposed personnel and to continue long-term treatments that increase the troops' odds of survival and act to restore the force to its full potency. Medical specialists train to recognize the signs and symptoms of CB warfare agent exposure, using specialized diagnosis instruments and methods. As not all CB warfare agents have vaccines or pre-treatments, patients may require evacuation and long-term care to return to full health.

Last, but perhaps most important, CB defense is very logistically demanding. The capability to resupply the force with protective suits, filters for the masks and collective protection systems, parts for the detectors, and decontaminants in bulk quantities is critical to succeeding in responding to the threat of CB warfare agents.

Summary

The preceding section on response focused on the warfighting aspects, but the responses undertaken by forces responding under consequence management, force protection, and even homeland security missions are very similar. In all cases, trained personnel are using technical equipment and doctrine to avoid harmful effects of exposure to CB hazards. The basic differences are the exact populations being protected, the level of risk assumed, the particular design of equipment, and the funding available to develop a protection strategy (see table 6.4). The major differences focus on the need for military forces to accept high risk using rugged and expensive equipment for short durations of time whereas civilian responders emphasize occupational safety during their missions,

TABLE 6.4
Comparing Military Response to Civilian Response

	Military Response	Civilian Response
Who develops federal policy and budgets?	Department of Defense	Department of Homeland Security
What is the threat?	NBC weapons affecting a large area on the battlefield	Improvised CBRN hazards affecting a small area within an urban center
Who is the target?	Military service members, healthy and trained, between 18 and 50	Unprepared noncombatants including the very young and very old
When and where is the attack?	During military combat operations on the battlefield	At any time and at any location across the nation
What is the assumed risk?	High probability of CB warfare agent exposure	Low probability of CB hazard exposure
What kind of equipment is used?	Military equipment designed for acute exposure, just enough to keep one alive	Commercial equipment designed to protect against low-level chronic exposure
How much equipment is needed?	Need enough for about two million people, plus supplies and replacements	Need enough for every emergency responder in every large town and major city

using more affordable, commercial gear, and must stay prepared throughout the year for any terrorist incidents.

For homeland security, for instance, the Bush administration's "Biodefense for the 21st Century" promotes a strategy of surveillance and detection, threat awareness, prevention and protection, and response and recovery. In essence, this is the same concept as the military's sense, shape, shield, and sustain. The BioWatch program uses air samplers to protect cities, the BioSense program links medical centers together, the BioShield program develops medical countermeasures, and DoD, FEMA, DHHS, and the EPA provide the federal response to support post-incident cleanup. Consequence management forces need sensitive and expensive detectors to ensure that contamination is gone and civilians can be allowed to return to a formerly contaminated area (sense). They use hazard prediction software to make decisions about where contamination hazards may remain (shape) and must wear hazardous material suits and masks (shield) in the "hot zones." And of course, they direct the post-incident cleanup effort, such as the efforts to decontaminate the Senate Hart building (sustain).

This chapter has intended to emphasize that it is not the end of the world merely because nations and terrorist groups invest in offensive CB warfare capabilities. People have studied these agents for many years. There are strategies intended to address these hazards and to allow military forces to continue their missions despite the presence of CB contamination. Although we may wish that these hazards did not exist, the fact is that CB warfare agents do exist and can kill unprepared people, potentially in large numbers. As a result, military forces and emergency responders across the world dedicate time and resources to understanding the threat and to developing capabilities to defeat adversaries despite the employment of CB warfare agents.

This combat edge is fragile, however. Military forces that do not train for the possibility of CB warfare and that neglect to stockpile the materiel necessary to conduct operations in a CB warfare environment will suffer unpleasant consequences. The defensive equipment and procedures exist, but it is up to the military leaders to ensure that their troops maintain their equipment and train to operate under CB-contaminated conditions. Because CB warfare agents are not always seen as a credible or likely threat, troops sometimes stop training. The equipment does not work if not maintained, and then the problems return. That lack

of preparedness nearly cost the U.S. forces that were preparing to oust Iraqi forces from Kuwait in 1991.

In the case of terrorist CB incidents, it is not possible to promise any city or any military installation that its personnel will be protected throughout the year against all CB hazards. The best form of protection is to stop the terrorists before they attack; once the hazards are released, people will die, just as if the terrorists used a bomb or machine gun. However, it is not necessarily going to be a mass casualty incident unless the terrorists successfully disseminate large quantities of CB warfare agents against a very large group of unprepared citizens. The goal is to develop a responsive strategy that is both implementable and cost-effective, given that terrorist CB incidents are a low-probability, high-consequence event. That means carefully managing funds to develop capabilities against the most likely vulnerabilities and highest risk areas rather than doling out equal amounts of money to every state and city. Again, it does little good to spend millions on stockpiles of vaccines, national networks of detectors, and piles of hazardous material equipment if they are not maintained or accessible.

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7

Case Studies

One of the challenges of talking about CB warfare in the abstract is that it can lead to further misunderstanding. People often cannot accurately visualize what a battle would be like if one or both sides used chemical or biological weapons, or if one or both combatants had the potential to use CB weapons but deliberately chose not to. What decisions are made? What assumptions are driving the decisions? On one side are arms control and anti-war proponents who see CB warfare as an aberration of humanity and science and refuse to conceptualize how the weapons work; they would rather see all these weapons simply eliminated. On the other side are the conventional military experts who, far from understanding the effects of CB warfare, "wish" the weapons away in wargames and plans because they complicate what would otherwise be a clean and predictable battle. This lack of perception of the true limitations of CB warfare feeds the mythology that surrounds this subject.

We can take a look at several case studies that exemplify the nature of CB weapons throughout history. The first will be the use of gas at Caporetto, Italy, which resulted in one of the worst routs of Italian forces during World War I. The second will be an evaluation of the use of chemical weapons by Egypt against the Yemeni royalists in 1968. Third will be the use of chemical weapons during the Iran-Iraq War during the 1980s. Fourth will be the preparations and actions taken by the United States during their military operations against Iraq in 1990–1991. The first two cases will be relatively short snapshots of the tactical use of chemical weapons in specific battles and the latter two will be longer discussions of the operational employment of chemical

weapons through an entire conflict. Finally, we will review the anthrax letter incidents of October 2001 as a terrorism case.

Gas at Caporetto

Most military analysts believe the use of chemical weapons was inconclusive in causing any changes in the outcome of World War I. The German military's superior appreciation of gas warfare did not shift the tide of the war in their favor, though not for lack of effort. In most cases, British and German use of gas weapons was not significant enough to give the side using the weapons the edge required to overcome the significant defenses and depths of trenchworks. On the western front at least, the two sides were simply too well matched for chemical weapons in and of themselves to tip the balance of combat. The use of chemical weapons on the eastern and Italian front, however, proved to be much different. In large part this was because the military commanders used them as a combat multiplier added to sound military tactics instead of relying on chemical weapons alone to win the battle. The best example of this in World War I was the use of gas against the Italian army at Caporetto in the fall of 1917.

Italy was a late joiner in the Great War, declaring war against Austria-Hungary in May 1915 and against Germany in August 1916. The Italian offensives against Austria were called the Battles of the Isonzo, of which there were twelve defined campaigns between July 1915 and December 1917. The eleventh battle had ended in September 1917 with the Italian army in full command of the mountain passes between the two countries and inside Austrian territory. The Italian fortifications, combined with the rough terrain, made it nearly impossible for the Austrian army to attack effectively.

Upon the Austrian government's request to the German government, six German divisions joined nine Austrian divisions to attack a twenty-five-kilometer stretch of lightly defended Italian positions in front of Caporetto on October 24, 1917. The Germans planned an initial barrage of gas and would use newly developed infiltration and shock tactics to overcome the fortifications and their defenders. (As an anecdotal note, one of the German officers who would receive an award for his actions during this offensive was one Lieutenant Erwin Rommel.) Although the Italian army was aware that the Austrian and German forces were preparing

an offensive, they either did not expect a gas attack or were confident that their positions were defensible enough, given the rugged mountains and their past successes against the Austrians, to stop any offensive. In fact, the local Italian commander near Caporetto had aggressively organized an offensive operation to attack the Germans' southern flanks.

The German divisions attacked at two in the morning using a mixture of phosgene and chlorine, employing more than 800 projectors and six tons of gas in an initial artillery barrage that lasted four hours. The Italian forces had no intelligence suggesting that a gas attack would occur, and they had little protection. Although this was not a heavy barrage compared to gas attacks against the British or French troops, the Italian gas mask, a copy of the French respirator, was of practically no use against phosgene. The chemical barrage had an instantaneous effect, and the Italians began to panic and retreat almost immediately. Their artillery could not counterattack with their crews helpless or deserting their posts. Because this was not a persistent chemical agent, the Austrian and German troops could attack the fortifications with limited protection and little danger to their own forces (Haber 1986, 77, 186).

By that afternoon, Austrian-German forces had taken Caporetto and penetrated about twenty-three kilometers into Italian territory. They continued to push into Italy until, running out of supplies and beginning to face stiffer resistance, they stopped on November 12 at the Piave River, about thirty kilometers north of Venice. Between 275,000 and 300,000 Italian soldiers were captured or became casualties (90 percent had surrendered), and the Italian forces lost all their trench artillery. The British and French forces, alarmed at the near collapse of the Italian army, rushed several divisions down to the Alps in November to stanch the impact of the offensive.

As suggested at the beginning of this section, the battles in which chemical weapons use resulted in a success for the attacker were few and definitely not the norm. Caporetto does demonstrate two important factors, however. First, the use of chemical weapons combined with conventional forces against unprepared troops resulted in a successful offensive operation. The use of chemical weapons was instrumental in providing Austrian-German forces with the edge to overcome mountain fortifications that conventional weapons and forces were unable to defeat. Second, this use of chemical weapons was a tactical

success; although the Austrian-German force penetrated deep into Italian territory, the operation itself did not lead to their winning the war or forcing Italy to withdraw from the war. Chemical weapons were not seen as an operational or strategic weapon, and they were certainly not seen as a weapon of mass destruction. The chemical weapons had not killed thousands of soldiers; they had merely disrupted the effectiveness of the Italian units to the point that they collapsed under pressure.

Egyptian Use of Chemical Weapons

The Yemeni Civil War (1962–1970) pitted the Yemeni royalists of the deposed imam against the Yemen republican forces in North Yemen, with Saudi Arabia and Jordan supporting the royalists and Egypt supporting the republican forces. This war was fought for five years until the two forces reached a stalemate in 1967. Although there had been occasional mentions of Egyptian military employment of mustard agent-filled bombs between 1963 and 1966, in 1967 these attacks became more frequent. International journalists began reporting that Ilyushin heavy bombers were dropping mustard-filled and phosgene-filled bombs on cities and rebel bases.

In January 1967, a gas attack near Sada killed more than 125 people. In May, two villages suffered 75 casualties from phosgene-filled bombs. Between 1967 and 1968, it is estimated that more than 1,000 Yemeni were killed as a result of exposure to CW agents. An International Red Cross mission sent doctors to assist the wounded, and the doctors testified to what they saw. Although they were careful to clarify that they did not see any evidence of actual attacks taking place, the signs and symptoms of the victims included burning eyes and trachea, pulmonary edema, internal thorax pain, extreme fatigue, and anorexia. Their findings were that in all probability these victims had inhaled toxic gases (Cookson and Nottingham 1969). The doctors were reluctant to identify the specific chemical warfare agents used, in part because they wanted to retain their neutrality and access to war victims. Although it appeared conclusive that mustard and phosgene had been used, a few cases suggested the use of nerve agent-filled bombs as well. The problem was how to prove the use of chemical warfare agents and who was responsible for using them. Because there were no arms control experts assigned

to monitor or investigate these attacks, there was very little evidence other than eyewitness accounts from civilians and what could have been propaganda from the royalists. Although bodies and samples were sent to Saudi Arabia for more study, again, it was difficult to accuse any specific nation. Egypt claimed it had not used chemical weapons in Yemen, and, according to some sources, this may be true if Soviet air crews were manning the Egyptian-marked bombers that attacked those cities.

When Saudi Arabia and the royalists tried to get the United Nations to investigate, the UN's secretary general, U Thant, declined. On March 1, 1967, he stated that he was "powerless" to investigate the issue, and that the facts were in sharp dispute. Although he almost certainly knew exactly what was going on in Yemen, he had made a political decision to stay out of the affair. The U.S. government, occupied with answering criticisms about the use of Agent Orange and riot control agents in Vietnam, chose not to get involved. The U.S. military decided that the chemical warfare attacks were an aberration and not reflective of any requirement to worry about future chemical warfare attacks (and in 1972, chose to disestablish the Chemical Corps). The United Kingdom was attempting to reestablish relations with Egypt at that time, so it chose not to say anything publicly against Egypt or Soviet affairs in the Middle East (Seagrave 1981, 124-125). The incident became a political nonevent, fodder for the arms control community but not much else.

This incident teaches several interesting lessons. The first is the failure of the world's nations to react against the use of chemical weapons against civilians and military forces that were not similarly armed. This was not a clear violation of the Geneva Protocol of 1925, since Egypt was not then (and still is not) a signatory of the Geneva Protocol, unless it could be proven that Soviet crews were in those bombers. The reason that some military analysts believe there were Soviet crews in the bombers was twofold: First, they do not believe that the Soviet Union would have allowed Egypt to own or employ chemical weapons in 1967, Egypt having just started its interest in an offensive CW program. Second, the bombers dropped their munitions upwind of their targets for maximum effect, and in some cases, MiG fighter planes came back to drop high explosives or napalm on and near the targets to reduce or eliminate the evidence. These same tactics were seen years later when the Soviet air force attacked Afghani villages with chemical weapons. Because the attacks occurred in

such remote locations and because post-mortem examinations took place days or weeks later, it was very difficult to directly attribute the cause of death to the bombing attacks.

This was the first instance of Arabs attacking Arabs with chemical weapons, but what is important is not to note whom they attacked but to understand why they did it. And again, the reason is that the two forces were at a stalemate using conventional arms, and one side decided to break the stalemate by adding the use of an unconventional munition. These unconventional arms succeeded in hastening the collapse of the royalist forces, and, as in the Caporetto case, the attacks cannot be described as the use of "weapons of mass destruction." Although in some cases more than 100 civilians died, this level of casualties could have just as easily been caused by a few extra bombing runs using high explosives. Using chemical weapons was more efficient than using conventional munitions, and the attacks were limited to tactical applications.

The Iran-Iraq War

In most accounts, Iraq's initiation of a war against Iran is seen as a mistake of bad timing and poor judgment. Saddam Hussein had been president of Iraq for about a year. Iran was in the throes of a civil war and its leader, Ayatollah Ruholla Khomeini, was calling for an overthrow of the Iraqi Ba'ath Party. Iran had alienated its former supplier of military equipment and training, the United States, through its hostage crisis of the previous year. It looked like an easy win to Iraq. Two years later, Iraq was on the ropes fighting for its life against heavy Iranian offenses driving into its oil-rich southern regions.

In mid-July 1982, Iraqi artillery fired artillery shells filled with riot-control agents into the advancing infantry to break up the unprotected troops. This attack, combined with heavy air and mechanized infantry attacks, stopped the Iranian infantry, who thought they were being attacked with chemical weapons. Iraq began firing Scud rockets against Iranian cities near the Iraqi border. Rather than capitulating, the Iranian army came back harder in human-wave attacks and night attacks (Mauroni 2000, 199–214).

In the summer and fall of 1983, Iraqi forces began to use mustard agent delivered by aerial bombs, helicopter sprayers, and artillery shells against the human-wave attacks. The unpro-

tected forces suffered thousands of casualties and were effectively driven back to the defense. When Iran reported these attacks to the United Nations, Belgian firms that had delivered thiodiglycol, a key chemical precursor for mustard agent, to Iraq stopped their shipments. By this time, Iraq was well on its way to developing an indigenous capability for producing mustard agent at its al-Fallujah complex.

In March 1984, Iranian forces attempted to force their way into central Iraq. They pushed through the wetlands where they thought that Iraqi armor and artillery would be slow to react. In some of the most ferocious fighting to date, the Iraqi military threw the Iranian forces back, using conventional forces and chemical artillery. These failures effectively stopped the Iranian military from assuming the offense through spring 1985. Iraq, however, was not sitting passively. It had been building more chemical munitions factories with the intention of developing nerve agents. Some analysts feel that Iraq used tabun and blister agents to counterattack against Iranian pushes in that spring. Although Iranian forces were somewhat better prepared, having bought chemical defense equipment in the global market, they were still sufficiently damaged by the attacks to fail to make any significant gains.

In 1986, Iraqi scientists began their biological weapons program at Muthanna State Enterprise. These studies would yield the needed experience to develop pilot plants and to initiate batch production of such BW agents as anthrax and botulinum toxin. Although Iraq did not have a sufficiently mature program to weaponize and employ these agents against Iran prior to the end of the conflict, this move to develop biological weapons was a clear and natural progression in developing the tools they felt they needed to combat Iran's forces.

In 1987, Iraqi military forces finally had enough hands-on training with chemical munitions and how to incorporate them into military operational plans to become truly effective. The preceding years had seen the occasional mishaps when Iraqi forces were mistakenly gassed by their own forces, but practice made perfect, as the Iraqi forces increasingly used chemical weapons to beat back the Iranian offensives. At least four times in 1987, Iraq used mustard and nerve agents to disrupt Iranian troop buildups around Basra. Iran's enlistment of Kurds in the north to attack Iraqi forces resulted in Iraq's use of chemicals against those towns from where the suspected fighters originated. Although there

were no major offensives in 1987, both sides rearmed to prepare for further conflicts.

When Iranian attacks into Iraq began to make headway in the north, Iraq responded by reinitiating attacks on Iranian cities with redesigned Scud missiles, which had a range that brought Tehran under fire. Iran responded as well as possible with ballistic missiles. During this "war of the cities," Iraq fired more than 200 Scud missiles at Iranian cities; although none had chemical or biological warheads, many Iranian citizens fled the large cities in fear that the next Scud would be so armed. Two major offensives in 1988, both of which featured chemical attacks, would cause Iran to eventually sue for a cease-fire.

The first offensive was Iraq's attempt to win back the Al Faw peninsula, which had fallen to Iranian forces years prior. On the first day of Ramadan, Iraqi forces massed and attacked a weakened and much smaller Iranian presence. The Iraqi army used artillery-delivered nonpersistent nerve and blood agents on the front lines, while its air force bombed the rear area troops, command centers, and reinforcements with mustard and nerve agent bombs. The combination of the six-to-one odds in troop numbers, two amphibious assaults, and good close air support resulted in a decisive defeat for the Iranian forces. Not more than a month later, Iran attacked to push Iraqi forces away from their defensive positions around Basra. In June, Iraqi use of chemical weapons continued to drive Iranian forces back. Continued attacks in the central and north sectors had similar results, allowing Iraq to gain all the territory it had lost in the earlier years, to include the Majnoon Islands and Hawizeh marshes. This series of Iraqi successes caused Iran to formally ask the United Nations to implement a cease-fire in August.

This is a very small snapshot of a long and dirty war, but several key points can be taken from this conflict. One is the relatively low loss of life from modern chemical weapons. About 45,000 Iranian casualties resulted from the direct employment of chemical weapons in a conflict that caused more than a million military and civilian casualties. The prediction that chemical warfare would result in hundreds of thousands of deaths was shown to be an overstatement. What military analysts observed was that CW agents did not have to kill all the troops; demoralizing the enemy force and degrading its capabilities to function was enough to tip the battle to the attacker's favor. Prompt attacks by conventional combat arms units against an unprepared

adversary that was reeling from a chemical attack often, if not always, resulted in a successful operation. Iraq did not fully master this operational strategy until 1987, when its forces had the requisite training and experience in chemical target analysis to mount effective attacks and to follow up on them. The end result of the offensive use of chemical weapons was that Iraq was able to stave off defeat from a numerically superior foe until that foe had become exhausted and worn down from these attacks.

This narrative focused on the battlefield applications of chemical warfare, but how Iraq developed its chemical and biological weapons is also of interest. Like many other countries, Iraq started with a basic knowledge of CB warfare, supported by the Soviet Union, and developed their chemical weapons production capability by purchasing equipment and materials from U.S. and European industrial firms. When these firms stopped their shipments, Iraq developed an indigenous capability to continue production. It was not until Iraqi scientists and military leaders became comfortable with chemical warfare agents and munitions that Iraq moved on to the development of an offensive BW capability. Iraq is not believed to have employed BW agents against Iran, but had the conflict not ended when it did, it may have been only a matter of time before Iraq did use BW agents.

Another point to observe is the relatively muted (again) tones of outrage from the rest of the world on the large-scale use of chemical weapons. Although European and U.S. government agencies moved to enact controls on the export of specific chemical precursors needed for chemical weapons, Iraq was already deeply involved in its chemical weapons program. Through dummy corporations and transactions through other countries, Iraq used the global economy to its benefit, creating a virtual model for developing countries that wanted a similar offensive CB warfare capability. There was very little response from the international community outside of public scoldings; in fact, a U.S. congressional delegation visited Saddam Hussein shortly after the Iran-Iraq conflict ended to resume trade talks on agricultural products. There were no calls for bringing Saddam to justice for using chemical weapons against Iranian military forces or even against his own people (until President George W. Bush noted these issues nearly fifteen years after the fact).

This conflict did have the result of increasing discussions on the issue of nonproliferation options. In 1984, while the Geneva talks on the Chemical Weapons Convention languished, a small

group of fifteen nations (led by Australia) started the Australia Group to discuss nonbinding resolutions to reduce the chance of nations developing offensive CB warfare programs by cooperatively crafting measures aimed at controlling exports of dual-use chemicals and equipment. The group recognized that the Geneva Protocol had done nothing to stop the use of chemical weapons in this conflict and that Iraq had clearly benefited from the international chemical industries in other nations. This group has doubled in size, to thirty-three plus the European Commission, and it continues to meet annually in Paris.

The irony of this conflict is, of course, that the United States would soon face this same threat that they had casually observed going on for years. The fears that U.S. military forces would face an actual CB warfare threat other than the Soviet Union's past capabilities brought in a great deal of soul-searching and scrambling for what the Iraqi threat really meant to the U.S. military, what steps they would have to take to protect their forces against CB warfare agents, and how they should attempt to respond to the threatened use or actual employment of these agents against U.S. forces.

Operation Desert Shield/Storm

The question of how U.S. military forces faced the Iraqi chemical warfare threat in 1990 is controversial for several reasons. First, a General Accounting Office review of U.S. military forces found that there was a general state of unreadiness in many units. This report was initially classified and was not released to the public until after the conflict, in May 1991. To this day, some military personnel, veterans' groups, and other critics feel that a large number of U.S. military forces were exposed to chemical or biological warfare agents, despite overwhelming medical evidence to the contrary. The lack of any CB warfare attacks by Iraq made it difficult to really tell whether U.S. military forces were adequately protected and prepared during Desert Storm. The constant fear of an incoming Scud missile carrying CB agents, the many false alarms, and the unanswered questions about Gulf War illnesses seemed to conflict with DoD's assertion that there were no Iraqi CB warfare attacks and that the troops were not exposed to CBW agents.

Initially, U.S. military forces were not well prepared to fight on a CB-contaminated battlefield, similar to their readiness at the onsets of the two world wars. They had modern CB defense equipment and enough specialists, but their training was not as good as it should have been. As in those previous conflicts, the military developed a capability to survive and sustain operations in this environment through hard training and by fielding specialized CB defense equipment, assisted by the efforts of more than 4,000 Army chemical specialists deployed throughout the force. Without the six months of preparation between August and February, however, this capability would not have been present (Mauroni 1998).

Although the Army's CB defense program had its renaissance period in the 1980s following its near demise in the 1970s, by the end of the 1980s the U.S. Army had become complacent. With the fall of the Berlin Wall and the apparent end of the Cold War, it appeared that there was no longer any peer adversary against which the United States would have to fight a sustained military conflict. Many military analysts had seen the Soviet Union as the only adversary against which the U.S. armed forces needed to develop CB defense programs. Without the European conflict scenario of NATO against the Warsaw Pact, many began questioning the need for a continued CB defense program. Even as the Iran-Iraq conflict dragged on for years and featured chemical warfare, there were no concerns within the Pentagon until August 1990, when Saddam Hussein's forces invaded Kuwait.

To say that the U.S. military and civilian leadership were concerned at that time would be an understatement. The Defense Intelligence Agency and the CIA dug up their assessments of Iraq's military operations during the Iran-Iraq conflict and identified the major CB weapons systems. They assessed Iraq as having mustard agent and nerve agents tabun, sarin, soman, VX, and possibly BZ. Iraqi chemical weapon systems included the Soviet-purchased 122 mm rocket launchers, helicopter-launched 90 mm rockets, 250 and 500 kilogram aerial bombs, 120 mm mortar shells and 155 mm artillery projectiles. Israeli intelligence stated the existence of Scud chemical warheads, but the main threat was seen to be the 155 mm artillery systems, since they had a greater range than the U.S. Army's 155 mm artillery and most of the chemical munitions were thought to be artillery projectiles. Estimates were that Iraq had up to 4,000 tons of chemical agents.

About biological agents, all the intelligence community had were guesses. Because Iraq had not used BW agents in its previous conflict, there were no hard data to go on. Analysts predicted that Iraq would have anthrax and botulinum toxin in weaponized form and was probably working on *Clostridium perfringens* (which causes gas gangrene in wounds), SEB toxin, and cholera. The intelligence community listed the same weapon systems as were used with CW agents, with the addition of ground and air spray generators. Between the Air Force and the intelligence community, the targeting list of CB weapons production and storage sites grew quickly.

The official estimate was that Iraq was likely to use chemical weapons as a part of tactical operations to protect against any offensive actions taken by the coalition forces. Chemical weapons would cause high casualties, and that was bad news, but not the worst. The military and political leadership knew that the military forces making up the coalition force would be very vulnerable to any biological attack: there was no vaccination program, there were no detectors, and there was very little training on how to recognize that a BW attack was taking place other than medical epidemiology after the fact. No one had any estimates on what the overall casualty rates would be from a BW attack, whether the agent was delivered by a Scud or released by a covert operation behind friendly lines.

When the Army's 82d Airborne Division deployed to go into Saudi Arabia along with the early deploying Marine Corps and elements of the Air Force, the forces realized that they would, for the first time in decades, face a credible foe with CB weapons. The 82d Division discovered that the soldiers' masks did not fit well, as many soldiers had selected larger masks than necessary, allowing for easier breathing with a loose seal. That would not do now that there was a real threat, but there was little time to replace the masks. The Marine Corps' pre-positioned stocks included dry-rotted protective masks and only one-tenth the number of protective suits as it thought were stored in war reserves. The Air Force and Navy had similar problems, lacking the protective suits and decontaminants they needed but had not purchased in years. A number of new detectors and a new protective mask were ready to come out of research and development, but there were not nearly as many as were required. The Saudi armed forces were in even worse shape, lacking all basic CB defense equipment and looking to the United States for assistance.

On top of all these logistical issues, all the military forces knew that their soldiers, sailors, airmen, and Marines were trained only on individual survival skills; very few military units had practiced CB defense in the field to gain the proficiency required to sustain operations in a CB-contaminated environment.

Because the Army was the only service that had a dedicated force structure for chemical defense, it moved to deploy these assets as quickly as possible. Most of the decontamination companies in the Army are in the reserves, which meant that more time was required to activate and prepare the soldiers for deployment. Although each Army division had a chemical company within its force structure, these were not enough to fully cover all the decontamination requirements in the theater. The first chemical decontamination companies deploying from the United States would come under the 2d Chemical Battalion, but they would not arrive until late September. Given the lack of supplies, the poor level of training, and the lack of dedicated CB specialists in theater, the forward forces would be very vulnerable for several months to any Iraqi combat action that included CB warfare.

What this meant to the political leadership was that they needed to bluff and gain some time. A massive media coverage of the troops showed every soldier and Marine practicing his or her mission in a chemical suit, or at the least, walking with a protective mask on his or her side. All military service members in theater, no matter where they were or what they were doing, kept their masks close by. The Bush administration sent Patriot missile units to Israel and Saudi Arabia, touting their protective features, as they were designed to knock any Scuds out of the sky. It certainly appeared that the use of CB weapons would have little effect other than to make the United States mad.

The Air Force Component (CENTAF) of U.S. Central Command (CENTCOM) continued work on their targeting strategy, with Iraq's NBC weapons sites one of the top priorities of offensive air operations. They also developed a Punishment Air Tasking Order that outlined the retaliation options if Saddam did release the use of chemical weapons. Secretary of State James Baker would meet with Iraqi Foreign Minister Tariq Aziz in Geneva to deliver a letter from President Bush warning the Iraqi government of the consequences of engaging in unconventional warfare. Along with other veiled (and not so veiled) warnings from administration figures and military analysts, the tone was set to inform Saddam Hussein that there would be a heavy price if he

were to use these weapons. Nonetheless, the military service members worried and trained harder.

For the first five months, the coalition forces brought in additional CB defense specialists and equipment while staying on the defense. Two chemical battalion headquarters deployed to support the Army corps, along with seven decontamination companies, seven dual-purpose (decontamination and smoke generator) companies, four NBC reconnaissance platoons (outfitted with donated German Fuchs vehicles), and several staff augmentation cells. In addition to the 4,000 chemical specialists attached to Army units, these 2,000 chemical specialists would give the coalition forces a robust support base. More than 1,500 physicians, nurses, and medical assistants would receive special training in the medical management of chemical and biological casualties.

Protective suits were initially in short supply, and none featured a desert camouflage pattern (the Army's focus being on the woodlands of Europe). More than 1.1 million protective suits were transferred from the United States and South Korea, while the Defense Logistics Agency made several contracts for accelerated production of more suits. Most of these would not arrive until March and April 1991, and as a result, most troops had only two protective suits each. Pine Bluff Arsenal sent a mask repair team into theater to inspect and repair as many masks as they could.

The time between August and December allowed the United States to borrow more than 1,000 Chemical Agent Monitors (CAMs) from Canada and the United Kingdom. While nearly every unit had an M8A1 Automatic Chemical Agent Alarm, the CAM, being a more sensitive manual detector, allowed for post-attack monitoring and verification that personnel and equipment were "clean." The M8A1 alarms came under suspicion because of a number of false alarms; however, these alarms could be attributed to one of three major issues: poor training (hitting the wrong switch), low batteries (which would cause the alarm to sound), and interference from pesticides or diesel products. In all cases of alarms, soldiers were trained to use the more sensitive M256A1 chemical detector kit to verify the presence or absence of agent.

The lack of means for biological detection was a serious shortcoming. Because biological detection had been assigned a lower research priority during the Cold War and because biological detection is very difficult in the first place, there were no devices available from any country. The U.S. military pulled out of the mothballs an old BW detection system created from past re-

search and development efforts, stripping it down and basically taking to the field an air sampler made sturdier to withstand field conditions. Along with several commercial air samplers and BW assay tickets, twelve teams of specialists spread out across the theater to provide an initial detection and verification of BW use if it were to occur. The problem was the time involved: the air sampler took an air sample every forty-five minutes, then the operator needed to check the samples, which then needed to be verified at an in-theater laboratory. During this time, the forces would be exposed to the BW agent, whatever it was. Although this was not an optimal arrangement, at the least U.S. forces would be able to verify if they had been attacked with a weaponized agent and could begin to take the appropriate medical countermeasures.

The military's solution to countering this shortfall was to rely on vaccines. There was the good news, that the United States had an FDA-approved anthrax vaccine, and the bad news, that the military did not have enough to vaccinate the entire force. Every soldier required six shots for the full vaccination therapy; after the first shot, a service member would receive a second shot two weeks later, a third at the four-week mark, then one shot at the six-, twelve-, and eighteen-month marks. The doctors theorized that at least two shots would give a person more than 85 percent chance of resisting anthrax infection. Even with a reduced shot schedule, only 150,000 of the half-million troops in theater could get the required shots.

The botulinum vaccine was not available for general release, so personnel receiving a shot had to volunteer to take the vaccination after being advised as to its safety risks. Only 8,000 doses of botulinum toxoid were available. If there was a way to delay the start of operations to May, the entire force could have been vaccinated, but there was no time. The British and United States announced their plans to vaccinate the troops at the end of December. The challenge was to determine who was at the greatest risk from BW attacks and who should receive the shots. Some thought the rear area was the more logical target; others felt the frontline troops should receive the medications. The division and corps commanders were very upset about being forced to choose who received the shots and who would not, stating that there should have been enough vaccine shots for everyone or for no one.

The coalition forces initiated their air offensive in mid-January, attacking Iraqi CB weapons production and storage sites along with key leadership and communication centers, air bases,

and key military infrastructure and military forces in Kuwait. Although the NBC sites were pounded, only about half of the Iraqi CB warfare program had been destroyed. More than 75 percent of production sites were out of business, but, as the postwar investigations would reveal, most of the munitions were still in play.

On the second day of the air offensive, Saddam countered with Scuds fired from mobile launchers moving around the desert. In the first week, twenty-five Scuds hit Israel and twenty-four Scuds hit Saudi Arabia. As the first missiles hit Tel Aviv, reconnaissance teams raced out to inspect the sites for the presence of chemical agents. Initial police reports indicated the presence of nerve agents, but these reports were later corrected as false alarms—a reaction to the nitric acid that fueled the Scuds. All the Scuds were armed with high explosives. The Patriot missiles made for a great light show, but their overall effectiveness was later proven to be less than optimal. The Scud attacks caused a political outcry for CENTCOM to hunt down and eliminate this threat. Searches from fighter plane sorties and special operations forces caused a decrease in the number of Scuds being launched, not due to any successful attacks but merely because of the increased urgency for the mobile launchers to “shoot and scoot” to cover.

In February, as the ground forces maneuvered to their starting positions, the fear continued that Iraq would attack any forces entering Kuwait or Iraq with chemical weapons. When the ground offensive kicked off on February 24, all forces crossing into the badlands were outfitted in protective clothing. A massive artillery and air attack on Iraqi forces was intended to keep any artillery from being able to target coalition forces with chemical weapons (the Iraqi air force had been absent from the fight for several weeks). As the forces moved swiftly through the Iraqi front lines, it appeared that there would be no chemical attacks. There was one incident in the Marine Corps’ 1st Marine Division sector: a mine had exploded with what some engineers thought was suspiciously low sound, a possible indication of a chemical-filled mine. The force stopped and assumed full protective posture. One NBC reconnaissance vehicle moved in to take a preliminary sample, which seemed to confirm a mustard agent, but subsequent tests with M8A1 alarms and M256A1 kits did not detect any agent. The Marines unmasked and drove on.

There were similar false alarms going on within the four days of military operations, but they had all been confirmed as nega-

tive. Either the speed of the military forces, the devastating air and artillery attacks, or the veiled threats of "massive retaliation" from the coalition allies had prevented Iraq's military commanders from employing CW agents. The only chemical agent exposure case occurred after military operations had ceased, when Private First Class David Fisher, a cavalry scout from the 3rd Armored Division, was inspecting an empty bunker in northern Kuwait for intelligence material. He brushed up against the wall of the bunkers and, several hours later, experienced blistering and pain along his arms. The medics evaluated him as a mustard agent casualty. Iraq had probably stored chemical munitions in this bunker during the Iraq-Iran conflict and later removed them. Outside of four blisters about an inch in diameter, the soldier was fine.

Concerns about potential Gulf War illnesses emerged years later, as controversies emerged regarding whether the coalition bombings of Iraqi production plants had exposed forces to low levels of chemical agents; whether Iraq had attacked coalition forces with CB warfare agents and the U.S. government had concealed these actions; and whether the post-conflict demolition operations at Khamasiyah were a source of low-level chemical agent exposure. All these cases are interesting discussion points but have nothing to do with the discussion of military operations against Iraq (and it would take another book to give these topics the proper details for that discussion).

Part of the reason this debate is so fierce is that everyone was so convinced that Iraq would use CB warfare agents against the coalition that it was almost a self-fulfilling prophecy. The United States knew Iraq had CB weapons—many of them were found after the war—and that the Iraqi military had the weapon systems and knowledge to effectively use CB warfare agents. We knew that U.S. forces were not well prepared or trained, and some of the chemical detectors had kept alarming. Why would Iraq not have used these weapons? Weren't the 70,000 plus cases of Gulf War illnesses a sign that something had occurred?

Barry McCaffrey, then a major general commanding the 24th Infantry Division, offered two insights as to why there had been no chemical warfare incidents. The forces had been equipped and trained well prior to the onset of offensive operations, and they had demonstrated this capability to the news media every opportunity they had. In August 1990, they had not been ready, but in February 1991, they were, in part because of the chemical

specialists in their units and in part because of the massive influx of CB defense material. They were prepared; they would have been miserable if attacked by chemical weapons, but the overwhelming majority knew they would survive.

These defense preparations alone might not have convinced Iraq that it would not benefit from the use of chemical weapons, but other factors might have done so. U.S. policy asserted the right to retaliate, and the Iraqi military did not know whether that retaliation would have been with chemical weapons (as the national policy would have allowed at that time), massive conventional strikes, or nuclear weapons. Steady diplomatic pressure from an international front, backed with promised retaliatory measures and a strong psychological warfare operation against Iraqi commanders warning them against using CB weapons, could have been a strong factor.

Other analysts postulate that Saddam Hussein was merely using the threat of CB weapons as a strategic bluff to keep the coalition forces out of Kuwait and Iraq. Certainly the threat had held up the coalition for several months as they developed their options and gathered more materials. Or maybe Iraq refrained from using chemical weapons because coalition forces stopped prior to reaching Basra; had they started taking cities in Iraq, maybe the order to use chemical weapons would have been given, as Saddam had done when Iranian forces threatened Basra in the 1980s.

Nevertheless, it can be said without going into a great deal of detail, there was essentially no medical or forensic evidence of any chemical or biological weapons use, and the thousands of medical and chemical defense specialists were looking very hard. Chemical weapons have very distinct signs and symptoms, and if anyone (such as Private Fisher) had been exposed to a CW agent, these specialists would have known about it immediately, not three or four years later. Many medical studies have pointed to other possible factors causing Gulf War illnesses, but all the experts have declared CB weapons as one of the least likely causes of Gulf War illnesses, if not flatly ruling them out altogether.

The lack of CB warfare has actually caused more questions than answers as to the proper defense against CB weapons. Many combat leaders feel that the Gulf War illustrated that one does not need CB defense equipment as much as one needs a

heavy conventional attacking force and threats of massive retaliation. Although the debate over the continued need for CB defense equipment continues (to this day), the U.S. military was convinced that they needed a strategy to counter non-nuclear countries' potential use of CB weapons. This led to the development of the counterproliferation strategy, which was detailed earlier in the book.

Mr. Anthrax Goes to Washington

Because of the recent concerns about the threat of CB terrorism, it may be instructive to discuss the anthrax-filled letters received in October and November 2001. Although these letters were received shortly after the September 11, 2001, terrorist incident, there has been no evidence to connect the two cases. Four letters containing anthrax were sent from a post office in Trenton, New Jersey. Two of these went to media outlets in New York City, and two were sent to the Washington offices of Democratic senators. Prior to the discovery of these letters, however, a citizen in Boca Raton, Florida, died as a result of pulmonary anthrax exposure.

Robert Stevens, a photo editor working for the tabloid *The Sun*, published by American Media, Inc., had fallen ill on September 30 and was brought to a hospital on October 2. When the hospital treating Stevens suspected he had pulmonary anthrax and alerted the CDC, the Federal Bureau of Investigation (FBI) came in to investigate. It was too late for Stevens, who died on October 5, 2001. At first, it was suspected that perhaps Stevens had contracted anthrax from natural sources, since this incident represented the first appearance of pulmonary anthrax in the United States in several decades. When another employee at the facility, a mail supervisor, contracted anthrax a few days later, it quickly became clear that this was not an accident. The second employee recovered after treatment with antibiotics. Although the FBI did not discover a letter, it was suspected that Stevens had opened a letter at his desk prior to leaving on vacation on September 26 and had inhaled a lethal dose of the spores.

About the same time Stevens had received his letter, a staff member working for NBC News in New York City opened a letter addressed to Tom Brokaw. She saw a doctor on October 1, who suspected she had contracted cutaneous anthrax. The letter

was postmarked September 18 from Trenton and had no return address. Both she and another employee were treated for anthrax exposure and recovered. Two weeks later, reports surfaced in New York City that the young child of an ABC employee and a staff member from CBS had tested positive for cutaneous anthrax. Although no letters were discovered, it was suspected that letters had been sent to the studios. These events, combined with the Florida incident, made it clear that these were not accidents but a deliberate terrorist incident.

On October 15, a staffer for Senate Majority Leader Tom Daschle (D-SD) opened a letter also postmarked from Trenton, dated October 9. It contained a brief message and a white powder, which was later identified as anthrax. Nearly thirty people in the building had been exposed, and they were given treatments of ciprofloxacin almost immediately. Only a few people were thought to have actually contracted pulmonary anthrax. The House of Representatives recessed in a panic, and investigators fanned out to identify where anthrax contamination might have spread and what other letters might have been sent. What they had overlooked was the main postal facility through which the letter had probably traveled. Postal workers in Trenton developed symptoms of cutaneous and pulmonary anthrax. Two postal workers from Washington's Brentwood postal facility died of pulmonary anthrax on October 22. Two additional workers were confirmed as having pulmonary anthrax the next day, with nine others showing symptoms. These workers have all recovered, following intense antibiotic treatments.

Federal agencies all over Washington implemented security measures to screen incoming mail, with some deciding to irradiate all mail prior to allowing it forward. Although these procedures let everyone's mail back for up to three months, they were successful in stopping a fourth letter, addressed to Senator Patrick Leahy (D-VT). Like the Daschle letter, it had a return address from a Greendale School in Franklin Park, New Jersey (although there is no such school in that town). This letter, unopened, was chock-full of anthrax spores and represented an important find for the investigators, who took this (and all the other letters) to the laboratories at Fort Detrick for analysis.

The anthrax powder was finely milled and coated with a surfactant that allowed the particles to literally "float" like a vapor. It was in a form that would have made it an ideal weapon,

thus the term "weaponized" anthrax (Preston 2002, 163–202). This peculiarity made some believe that the anthrax had to have come from a nation that had invested in an offensive BW program and had possibly been delivered by a foreign terrorist group. Others suspected that the person who sent the letters could be someone inside the U.S. Army's CB defense community, perhaps a scientist from Dugway Proving Ground or Fort Detrick. Yet FBI profilers do not believe this is necessarily the case; the pattern of sending these letters to media outlets and Democratic senators seems to be the pattern of a male loner or militant with a scientific background. Despite a national investigation that remains open today, the perpetrator remains at large. Whether he or she will strike again is unknown; did the perpetrator use up all the available stocks, or is this individual just afraid of being caught? In all, it is believed that at least twenty-two people contracted anthrax, of whom eleven contracted cutaneous anthrax and eleven contracted pulmonary anthrax. Five people died, including an elderly lady in Connecticut (demonstrating the frightening aspects of the perhaps unintentional cross-contamination of letters in the postal delivery service).

Without going into too much depth here, there are a number of interesting follow-on issues arising from this incident. One might comment on the vulnerability of the public within the United States to acts of terrorism, when this case of deliberate and repeated attacks cannot be tracked down and closed. One might also observe the thousands of hoax incidents that arose from these events, some of them meant to be in jest and many others merely capitalizing on people's fears. This incident has driven a strong response from the U.S. government to prepare and issue guidance to federal, state, and local agencies on how to address future terrorist CB incidents. However, in the opinion of this author, the U.S. government guidance that citizens should prepare "safe rooms" in their homes, using plastic sheeting and duct tape, is very misguided. No amount of plastic sheeting would have saved the five individuals who died from pulmonary anthrax in 2001, and certainly no safe rooms would have protected the hundreds of people who were exposed to anthrax while they were at work. It will take a more serious analysis and understanding of the threat of CB terrorism and effective measures to counter these incidents before the American people can take rational steps to be prepared against future attacks.

Summary

Whenever one force has used CB weapons in conjunction with conventional weapons against an unprepared force, the offensive force wins, and wins quickly. That is the value of CB weapons. If the defending force fails to persuade the attackers not to use CB weapons, whether through diplomacy or threats of retaliation, or fails to intercept the weapons before they disperse their payloads, this force will require the appropriate protection to maintain its ability to conduct combat operations. This lesson has been repeated throughout history, and the military force that does not understand this lesson will ultimately be defeated.

The first four case studies have nothing in common with the more recent issue of CB terrorism, for the terrorist incidents target civilians completely unprepared and unschooled in the area of CB warfare, but one parallel can be offered: the key to responding to CB warfare agents, whether on the battlefield or in a city, lies in knowledge, training, and equipment. If our investments in any of these three areas decline, then the potential impact of a CB weapons attack increases in scope. Consider that the DoD investment in CB defense has amounted to less than one half of one percent of the total DoD budget for decades. When the actual threat arises, the military and political leadership often thinks a quick transfusion of funds to buy the necessary equipment right before the troops hit the field will solve the matter. These simplistic attitudes continue to be the true source of risk for U.S. forces on the modern battlefield, forcing the troops to "cram" to increase their readiness rather than to maintain an acceptable defensive level before the crises occur.

Similarly, investing billions of dollars to prepare the public for the impact of biological terrorism may be wasted if the attempt is to try to protect every citizen in every town for every day throughout the year with inadequate resources. As rhetoric continues about the threat of BW terrorism, thousands die from influenza and other natural diseases every year. CB terrorism is a distinct threat requiring a distinct approach from military warfare preparations, but the technology and general concepts of protection are similar. As long as the military and political leadership view CB warfare as an aberration and do not put the threat in context with potential solutions, the failure to adequately invest in a robust CB defense capability will continue to put military service members and civilians at risk.

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8

Directory of Organizations

A number of organizations, associations, and private and governmental agencies are involved in the business of CB defense and CB warfare, and more are coming into existence every year. A small number are arms control agencies, some are think tanks, others are commercial companies supporting the military, and most are government agencies. In the past, this area has not had much commercial interest. However, there is a growing interest by those who have begun looking into the CB defense aspects of Homeland Security. This chapter will focus more on the agencies that work primarily in CB defense and what they do rather than on the many industries involved in the business of producing CB defense products for federal, state, or local governments. Chapter 9 will include sources of information from companies and other agents involved in CB defense but not necessarily as primary agents.

This chapter lists governmental/military organizations first, and private organizations second. There are many federal agencies and organizations such as the National Security Council which deal with counterproliferation or homeland security issues relating to CB warfare. In the interests of focusing the reader's time and energy, I will list only those agencies and organizations whose majority of work is in addressing CB warfare topics. As with any reference book, this information may be ephemeral. Internet addresses change; agencies change their names or reorganize. But the majority of these groups should remain active. Some of these agencies are relatively young whereas others have worked in this area for many years, and, no doubt,

new ones are coming. Some agencies will not be open to research questions from the general public, but most are, and one can always ask the questions and start a dialogue.

Governmental/Military Groups

The Australia Group

c/o The Australian Embassy

4 rue Jean Rey

Paris 75724 France

http://www.australiagroup.net/index_en.htm

The Australia Group is an informal group of nations that aims to allow exporting or trans-shipping countries to minimize the risk of assisting CB weapons proliferation. The group meets annually to discuss ways in which the national level export licensing measures of its thirty-nine participants (plus the European Commission) can collectively be made more effective in ensuring that would-be proliferators are unable to obtain necessary inputs for CB weapons programs, which are banned under international law.

Participants in the Australia Group do not undertake any legally binding obligations: the effectiveness of the cooperation between participants depends solely on their commitment to CB weapons nonproliferation goals and the effectiveness of the measures they each take on a national basis. Their principal objective is to use licensing measures to ensure that exports of certain chemicals, biological agents, and dual-use manufacturing facilities and equipment do not contribute to the spread of CB weapons. All states participating in the Australia Group are parties to the Chemical Weapons Convention and the Biological Weapons Convention and strongly support efforts under those conventions to rid the world of CB weapons.

Center for the Study of Weapons of Mass Destruction

300 Fifth Avenue SW

Fort Lesley J. McNair

Washington, DC 20319-5066

<http://www.ndu.edu/WMDCenter/index.cfm>

The WMD Center, formerly known as the Center for Counterproliferation Research, has a broad mandate for education and research in the areas of nonproliferation and counterproliferation

policies and programs, doctrine and training, and NBC operational effects. Its small staff, residing at the National Defense University, conducts its research and hosts collaborative meetings with defense civilians and military leaders to enhance their awareness of the challenges and requirements for operating in an NBC environment and to shape defense policy, programs, and military operations. The Center has a number of publications discussing the challenges and issues of CB defense and terrorism.

Central Intelligence Agency (CIA)

Office of Public Affairs

Washington, DC 20505

(703) 482-0623

<http://www.cia.gov/>

The CIA collects intelligence data on foreign governments and terrorist organizations outside the United States and provides analysis to the White House, Congress, and other federal agencies. Part of this intelligence collection and analysis is on CB warfare programs of foreign governments and terrorist groups, which may be provided in the form of a special report (such as the National Intelligence Estimate on Iraq's WMD program in October 2002) or as testimony to a congressional committee. The director of Central Intelligence has been tasked by Congress to submit a biannual report on the "acquisition by foreign countries . . . development or production of weapons of mass destruction . . . and trends in the acquisition of such technology by such countries." As a result, a branch of the CIA called the Weapons Intelligence Nonproliferation and Arms Control Center (WINPAC) drafts a report and coordinates it through the intelligence community. These reports are unclassified and available to the public on the CIA's website. Within the past few years, this report has also grown to address the threat of terrorists using CBRN materials in potential attacks against the public.

During Operation Iraqi Freedom, the Iraq Survey Group (ISG) reported to the CIA as it conducted its search for evidence of Iraq's WMD program. The ISG's reports are on the CIA website. Other intelligence community members that coordinate with the CIA on CB warfare issues include the Defense Intelligence Agency's National Ground Intelligence Center (NGIC) and Armed Forces Medical Intelligence Center (AFMIC) and the State Department's Bureau of Intelligence and Research.

Centers for Disease Control and Prevention (CDC)

1600 Clifton Road
Atlanta, Georgia 30333
(404) 639-3311
<http://www.cdc.org/>

The CDC falls under the Department of Health and Human Services and is recognized as the lead federal agency for protecting public health and safety. It focuses on developing and applying disease prevention and control, environmental health, and health promotion and education activities designed to improve the health of those living in the United States. The CDC has been involved with CB warfare and defense issues since at least 1970. Its activities in this area include reviewing aspects of the chemical demilitarization program, creating acquisition and transfer protocols for selected biological agents within the United States, and working with the Department of Defense on medical surveillance and occupational health safety standards related to CB warfare agents. The CDC is, of course, deeply involved in national issues involving the federal government's preparations for and response to a potential BW terrorist incident in the United States.

Chemical-Biological Incident Response Force (CBIRF)

Indian Head, Maryland
(301) 744-2034
<http://www.cbirf.usmc.mil/>

In 1995, General Charles Krulak, commandant of the Marine Corps, directed the development of a dedicated Marine response force to support federal response to state and local requests for assistance in responding to terrorist CBRN incidents. He felt that the available federal agencies (to include the Army's Technical Escort Unit) were not sufficient to support requests from a city or state for federal assistance. This 350-plus unit provides capabilities for agent detection and identification; casualty search, rescue, and personnel decontamination; and emergency medical care and stabilization of contaminated personnel. In addition to preparing for domestic and overseas consequence management operations and supporting national security special events, the CBIRF also conducts force protection training for fleet units.

**Chemical and Biological Defense Information Analysis
Center (CBIAC)**

P.O. Box 196
Gunpowder, Maryland 21010-0196
(410) 676-9030
<http://www.cbiac.apgea.army.mil/>

The CBIAC is one of a number of information analysis centers overseen by the Defense Technical Information Center. Its mission is to generate, acquire, process, analyze, and disseminate CB science and technology information for government, military agencies, and private agencies under contract to the government. Its information collection contains just about every aspect of technical analysis of CB warfare, from warfighting requirements to domestic preparedness to treaty issues. Its products include handbooks, databases, and a quarterly bulletin in addition to its data gathering and dissemination function. In general, the center does not conduct research or offer access to its bibliography to the general public.

Defence Research Establishment—Suffield (DRES)

Box 4000, Stn Main
Medicine Hat, Alberta T1A 8K6, Canada
(403) 544-4655/4656
[http://www.dres.dnd.ca/ResearchTech/Products/
CB_PRODUCTS/index_e.html](http://www.dres.dnd.ca/ResearchTech/Products/CB_PRODUCTS/index_e.html)

DRES is the Canadian government laboratory equivalent to the U.K.'s Defense Science and Technology Laboratory and U.S. Army's Edgewood Chemical and Biological Center, researching and developing CB defense equipment to provide Canadian forces with the capabilities required to survive and sustain combat missions in contaminated environments. Its scientists have cooperatively worked research and development efforts with the United States and United Kingdom since World War II. Over the years, DRES has generated a considerable reservoir of knowledge, not just of CB warfare agents and their toxicology and infectivity but also of the behavior of liquids, gases, and aerosols released in the atmosphere.

**Defence Science and Technology Laboratory (DSTL)—
Porton Down**

Dstl Porton, Salisbury
Wiltshire SP4 0JQ, United Kingdom
<http://www.dstl.gov.uk/>

The Dstl was formerly known as the Defence Evaluation and Research Agency (DERA), the military science and technology advisor and developer for the U.K.'s Ministry of Defence. Porton Down, in particular, is the main laboratory that researches chemical and biological defense issues. Porton Down and the United State's equivalent, Edgewood Arsenal in Maryland, have been cooperatively working together on CB defense topics such as detection and medical countermeasures since 1917. Dstl also addresses chemical weapons demilitarization and disposal of hazardous chemicals in Europe as well as within the United Kingdom. In addition to sharing a past in weaponizing CB warfare agents, the two sites also share some controversy as to human volunteer testing of CB warfare agents.

Defense Advanced Research Projects Agency (DARPA)

3701 North Fairfax Drive
Arlington, Virginia 22203-1714
(703) 526-6630
<http://www.darpa.mil/spo/>

DARPA is the central research and development organization for DoD in the area of basic science and technology and applied research and development projects. It specializes in pursuing areas that have both a high risk and potentially high payoff, areas that may be commercially risky for private agencies to explore. In the CB defense area, DARPA's Special Projects Office specializes in researching biotechnology, decontamination, collective protection systems, and medical biological defense efforts. When these research areas become mature and show potential for applications, DARPA transitions the information to the appropriate military laboratories.

Defense Logistics Agency (DLA)

8725 John J. Kingman Road
Suite 2545
Fort Belvoir, Virginia 22060-6221
(703) 767-6200
<http://www.dla.mil/>

DLA is a major DoD defense agency created during World War II, supplying the nation's military services and several civilian agencies with equipment, spare parts, and practically all the consumable items the military needs to operate, in addition to pro-

viding logistics support as required. In regard to CB defense, DLA procures and distributes protective clothing (jackets, trousers, boots, and gloves), medical defense countermeasures, and decontaminants. Although its headquarters is at Fort Belvoir, the Defense Supply Center Philadelphia is the main hub for distributing CB defense protective clothing and medical countermeasures such as atropine autoinjectors.

Defense Threat Reduction Agency (DTRA)

8725 John J. Kingman Road
Fort Belvoir, Virginia 22060-6201
(703) 767-5870
<http://www.dtra.mil/rd/cbt/index.cfm>

DTRA was formed in 1998 from the former Defense Special Weapons Agency (which was Defense Nuclear Agency, and before that, Defense Atomic Support Agency, and originally the Armed Forces Special Weapons Project) and other government agencies, created under Defense Secretary William Cohen's Defense Reform Initiative. DTRA combines DoD resources, expertise, and capabilities to ensure that the United States remains ready and able to address the present and future WMD threat. This includes technical and combat support to the combatant commands, CBRN defense science and technology, and threat-reduction missions. In addition to its research and development and operational support directorates, DTRA is home to the Center for Combating WMD, an organization sponsored by the U.S. Strategic Command (STRATCOM), and it manages STRATCOM's responsibility to integrate and coordinate DoD's capabilities for combating WMD.

Department of Agriculture

1400 Independence Avenue, SW
Washington, DC 20250
<http://www.usda.gov/wps/portal/usdahome/>

The U.S. Department of Agriculture (USDA) has the responsibility to address agro-terrorism related initiatives and the protection of livestock and crops from disease. One of its programs is at the Plum Island Animal Disease Center, off the northeastern tip of New York's Long Island. Scientists from the USDA Animal and Plant Health Inspection Service (APHIS) and Agricultural Research Service (ARS) research ways to improve the ability of

U.S. inspectors to protect agricultural production, processing and marketing systems, and the abundance and safety of the food supply.

Department of Homeland Security (DHS)

Emergency Preparedness and Response

Federal Center Plaza

500 C Street, SW

Washington, DC 20472

(242) 646-3900

<http://www.dhs.gov/dhspublic/display?theme=17>

Among the many responsibilities of DHS is the directive to coordinate any federal response efforts supporting state and local requests for federal assistance in response to terrorist CBRN incidents. In addition to the Federal Emergency Management Agency (see below), DHS can deploy a Nuclear Incident Response Teams (NIRT), in cooperation with the Department of Energy and Environmental Protection Agency, with personnel trained to assess and disable radiological or nuclear devices, provide intelligence analysis, assess the credibility of threats, and provide information on health physics. The Domestic Emergency Support Team (DEST) provides interagency support in the form of advice and guidance to the on-scene commander of a domestic terrorism event involving WMDs. The National Medical Disaster System (NMDS) is responsible for supporting the coordination of federal medical response to major emergencies and federally declared disasters including acts of terrorism involving WMDs. The Metropolitan Medical Response System (MMRS) program supports states and local governments in dealing with mass casualty incidents during the early hours that are critical to life-saving and population protection by funding plan development, equipment acquisition, and training and exercises.

Department of Homeland Security (DHS)

Science and Technology (S&T) Directorate

Federal Center Plaza

500 C Street, SW

Washington, DC 20472

(242) 646-3900

[http://www.dhs.gov/dhspublic/interapp/editorial/
editorial_0530.xml](http://www.dhs.gov/dhspublic/interapp/editorial/editorial_0530.xml)

The S&T Directorate is the primary research and development arm of the Department of Homeland Security, providing federal, state, and local officials with the technology and capabilities to protect the homeland. This includes the development and deployment of equipment, protocols, and training procedures to respond to and recover from terrorist CBRN incidents. The S&T Directorate oversees the Homeland Security Advanced Research Projects Agency (HSARPA) and the BioWatch program, which employs air sampling devices in several metropolitan areas across the country to detect terrorist use of BW agents.

Department of Homeland Security (DHS)
Federal Emergency Management Agency (FEMA)
Federal Central Plaza
500 C Street, SW
Washington, DC 20472
(202) 566-1600
<http://www.fema.gov/>

FEMA's mission is to prepare for, prevent, respond to, and recover from natural and man-made disasters. Although the majority of its tasks address natural disasters, FEMA also leads the preparation for potential CW agent accidents and incidents in communities near the Army's chemical weapons stockpiles in the United States. It is the keeper of the National Response Plan, which establishes the process and structure for a coordinated delivery of federal assistance to address the consequences of any major disaster or emergency declared under the Stafford Act. In 2001, this included preparing for terrorist CBRN incidents, both reducing the vulnerability of people and property to terrorist acts and preparing for the response and recovery from a terrorist act. Following the formation of DHS and development of the National Response Plan, the responsibilities for terrorism planning and response actions have been assigned to other agencies. FEMA continues to focus on an "all-hazards" approach to disasters—both natural and man-made—and homeland security issues.

Department of Energy (DOE)
1000 Independence Avenue, SW
Washington, DC 20585
(800) 342-5363
<http://www.energy.gov/nationalsecurity/wmd.htm>

The DOE has several initiatives in the area of CB defense, most being detection programs executed through its national laboratories. Sandia National Laboratory is in New Mexico, Lawrence Livermore National Laboratory is in California, and Los Alamos National Laboratory is in New Mexico. These labs, once more prominent in nuclear arms research, execute most of the DOE's CB defense research and development efforts, often with an eye to developing CB defense equipment for emergency responders, while coordinating their technology efforts with DoD. Oak Ridge National Lab has supported several chemical demilitarization analyses.

Department of Health and Human Services (DHHS)

200 Independence Avenue, SW

Washington, DC 20201

(202) 619-0257

<http://www.dhhs.gov/emergency/index.shtml>

In addition to its traditional role in developing and executing public health policy and directives, DHHS coordinates federal health and medical assistance to state and local authorities responding to a terrorist CBRN incident. The CDC, as a subordinate organization of DHHS, has already been discussed above. DHHS also executes the BioShield initiative, a \$5 billion multi-year federal program designed to encourage pharmaceutical industries to develop and produce medical countermeasures that might be used in response to bioterrorism events. The DHHS is responsible for developing and maintaining a national stockpile of vaccines for anthrax, smallpox, and other BW agents as well as distributing the vaccines in the event of a terrorist BW incident. The National Institutes of Health (NIH) act as the federal focal point for biomedical research, including vaccine research and development in support of bioterrorism preparedness. The main biodefense research effort within NIH is the National Institute of Allergy and Infectious Diseases (NIAID).

Department of Justice (DoJ)

Federal Bureau of Investigation (FBI)

J. Edgar Hoover Building

935 Pennsylvania Avenue, NW

Washington, DC 20535-0001

(202) 324-3000

<http://www.fbi.gov/hq/lab/org/hmru.htm>

The FBI is responsible for preventing terrorist activity within the United States as well as coordinating domestic intelligence collection and the conduct of foreign counterintelligence investigations. In addition, the FBI has a laboratory division that can provide forensic services in support of law enforcement activities. The Hazardous Materials Response Unit (HMRU) is designed to safely and effectively respond to criminal acts and incidents involving the use of chemical, biological, and radiological hazardous materials.

Department of Veterans Affairs

Washington, DC 20111

<http://www.va.gov/>

The Department of Veterans Affairs is closely involved with health issues related to exposure or suspected exposure of CB warfare agents and herbicides. This work includes funding several grants at universities and other academic centers for research into the potential effects of CB warfare exposure. The Department is currently working with the Defense Department on issues such as Project SHAD, Agent Orange, Gulf War illnesses, and low-level chemical warfare agent exposure studies.

Dugway Proving Ground

Commander, U.S. Army Dugway Proving Ground

ATTN: Public Affairs Office

Dugway, Utah 84022-5000

(801) 831-5187

<https://www.dugway.army.mil/sites/local/>

Dugway Proving Ground is the Army's test and evaluation center for CB defense, smoke and obscurants, illumination, and munitions research and development efforts. It is a designated DoD major range and test facility base, reporting to the Army's Test and Evaluation Command, located about ninety miles from Salt Lake City. Built during World War II, the center is most famous for its role in the alleged sheep poisoning incident of 1968. While there are no more open-air toxic CB agent tests conducted at the site, it does continue to support open-air simulant tests of CB defense

equipment as well as toxic agent tests of equipment within specially designed and protected facilities.

Edgewood Chemical Biological Center (ECBC)

ATTN: AMSRD-ECB-AP-B

5183 Blackhawk Road, Bldg. E3330

Aberdeen Proving Ground, Maryland 21010-5424

(410) 436-3610

<http://www.ecbc.army.mil/index.htm>

ECBC is the nation's principal research and development center for nonmedical CB defense technology, engineering, and service. Although its name has changed several times since 1917, its mission of providing the military with the majority of its detection, protection, and decontamination equipment has remained constant. The labs have also developed flame munitions, riot control agents, and herbicides for use by the military. It was responsible for the development of CB warfare munitions before the United States ended its offensive programs, and it currently supports the Army chemical demilitarization program. ECBC also supports the research and development of smoke and obscurant systems for the Army. An Army reorganization in 1998 created the U.S. Army Soldier and Biological-Chemical Command (SBCCOM) to supervise the center as well as the Army's soldier system products office at Natick, Massachusetts. In 2004, the Army created the Research, Development and Engineering Command (RDECOM) as the overarching headquarters for its laboratories (to include ECBC). The ECBC website features a quarterly *CB Journal* featuring articles on the organization's research and development efforts.

Environmental Protection Agency (EPA)

Chemical Emergency Preparedness and Prevention

Ariel Rios Building

1200 Pennsylvania Avenue, NW

Washington, DC 20460

(202) 272-0167

<http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/ct-epro.htm>

The EPA is required to prepare for and respond to any release or threat of release of oil, hazardous substances, pollutants, or contaminants into the environment that may present an imminent

and substantial threat to the public health or welfare and the environment. Along this line, it is also expected to support any federal response to a terrorist CW incident by providing experts to help state and local responders plan for emergencies, train first responders on hazardous material issues, and provide resources in the event of a terrorist incident. The EPA's Chemical Emergency Preparedness and Prevention Office works with state and local partners to deal with emergency preparedness and accident prevention, including potential terrorist attacks against U.S. chemical facilities that might cause a mass casualty event. The EPA also assists the Army in monitoring the output of waste products and other emissions from its chemical demilitarization disposal facilities.

Food and Drug Administration (FDA)

5600 Fishers Lane

Rockville, Maryland 20857-0001

(888) 463-6332

<http://www.fda.gov/opacom/hottopics/bioterrorism.html>

The FDA's mission is to promote and protect the public health by helping safe and effective products reach the market in a timely way; to monitor products for continued safety after they are in use; and to help the public get the accurate, science-based information needed to improve health. The FDA has a bioterrorism focus in being prepared to respond to any BW threat that might appear in commercial food or drug products. The website cited above has various information papers and resources for those interested in public health initiatives, food security, and commercially available vaccine treatments.

Interagency Board (IAB) for Equipment Standardization and Interoperability

<http://www.iab.gov/>

The IAB is a joint DoD-DoJ board responsible for the standardization and interoperability of equipment and research and development of advanced technologies to assist first responders at the state and local levels in establishing and maintaining a robust crisis and consequence management capability. The IAB is responsible for the Standardized Equipment List (SEL) for use by first responders in preparing for and responding to terrorist CBRN incidents. The IAB is composed of local, state, and federal

government representatives and currently hosts three committees and five subgroups. The committees are a federal agency coordinating committee, a standards coordination committee, and a science and technology committee; the subgroups are a personal protective and operational equipment subgroup, an interoperable communications and information system subgroup, a detection and decontamination subgroup, a medical subgroup, and a training subgroup. Each group (except for the first) is chaired by a first responder, supported by a federal government co-chair, and staffed with subject-matter experts who are responsible for a subsection within the SEL. In general, the group releases an annual report noting their work and any updates to the SEL.

Joint Program Executive Office for CB Defense (JPEO CBD)

5203 Leesburg Pike

Suite 1609

Falls Church, Virginia 22041-3203

(703) 681-9600

<http://www.jpeocbd.osd.mil/>

In April 2003, the DoD reorganized its management approach to developing CB defense equipment; switching from a joint committee-managed process that allocated tasks to the four services, DoD created a single point of contact for all military CB defense research and development programs (except DARPA). As the Army is the DoD executive agent for CB defense, its former acquisition office for CB defense became the core for a joint program executive office. The JPEO oversees and directs all acquisition efforts for the military services, relying on laboratories at Aberdeen Proving Ground, Natick, Quantico, Dahlgren, Fort Detrick, and San Diego for the actual execution of military acquisition efforts. Together, they develop, produce, field, and sustain all the military NBC defense systems for the Army and much of the other military services. The JPEO website features a magazine called the *Chem-Bio Defense Quarterly*, which features people and projects within the organization.

**Joint Requirements Office for Chemical, Biological,
Radiological, and Nuclear Defense (JRO-CBRND)**

Joint Chiefs of Staff

ATTN: J8/JRO

8000 Joint Staff Pentagon

Washington, DC 20318-8000

<http://jro-cbrnd.cbiac.apgea.army.mil/Home.aspx>

The JRO-CBRND formally began operations on October 1, 2002, as the single office within the Department of Defense under the chairman of the Joint Chiefs of Staff to be responsible for the planning, coordination, and approval of joint chemical, biological, radiological, and nuclear defense operational requirements, medical and nonmedical, and to serve as the focal point for service, combatant command, and Joint Staff requirements generation. Currently, the director of the Joint Theater Air-Missile Defense Organization (JTAMDO) is also the director of the JRO; an Army colonel and staff run the day-to-day affairs of advocating the military's needs for CBRN defense capabilities and addressing CBRN defense policy issues. This office addresses all CBRN defense requirements generation and program analysis issues within passive defense, consequence management, force protection, and homeland security, and it collaborates with appropriate Joint Staff elements on appropriate policy, operational readiness, logistics, and sustainment issues relating to CBRN defense.

Joint Chiefs of Staff (JCS)

9999 Joint Staff Pentagon

Washington, DC 20318-9999

<http://www.jcs.mil/>

Although the JRO-CBRND addresses most CBRN defense issues, its focus is on development of equipment and concepts for CBRN defense. The Joint Staff has four other primary offices addressing aspects of CB warfare policy and logistics. The J3 (Operations Directorate) has a Deputy Director for Antiterrorism and Homeland Security to coordinate domestic consequence management policy issues and a Deputy Director for Global Operations to address the deployment of military assets in support of foreign consequence management operations, which may include terrorist CBRN attacks against U.S. personnel or overseas bases or host nation government facilities. The J4 (Logistics Directorate) is home to the Joint Staff Surgeon and a Health Service Support Division, which addresses issues such as medical vaccination policy and the monitoring of force health protection issues (including the possibility of chronic exposure to CB warfare agents). The J5 (Strategic Plans and Policy Directorate) has a WMD Division under its Deputy Director for War on Terrorism, which coordinates strategy and policy

issues associated with the DoD's mission of combating WMD throughout the world. There is also a Homeland Security Division in J5, which addresses military policy, plans, and strategy related to DoD efforts in homeland security.

Natick Soldier Systems Center (SSC)

Kansas Street

Natick, Massachusetts 01760

(508) 233-4001

<http://www.natick.army.mil/>

The U.S. Army's Soldier Systems Center is responsible for researching, developing, fielding, and managing food, clothing, shelters, airdrop systems, and soldier support items. Although it is perhaps better known for having developed Meals Ready to Eat (MREs), tents, parachutes, soldiers' uniforms, and other clothing items, the SSC also develops chemical protective suits and transportable collective protection shelters.

National Guard Bureau

Jefferson Plaza 1

1411 Jefferson Davis Highway

Arlington, Virginia 22202

(703) 607-2584

<http://www.ngb.army.mil/>

The National Guard Bureau is a joint bureau of the Departments of the Army and Air Force, overseeing the Army National Guard and Air Force National Guard units. The National Guard units report to the governors of their respective states or territories when not mobilized or under federal control. In response to a DoD directive, the National Guard Bureau created WMD Civil Support Teams, responsible for deploying rapidly to assist local incident commanders in the event of a terrorist CBRN incident. Each team has twenty-two full-time members who are federally resourced, trained, and exercised, and who operate by federally approved CBRN defense doctrine. They can determine the nature and extent of a CBRN incident, provide expert technical advice on response operations, and help identify and support the arrival of follow-on state and federal military response assets. In 2005, the National Guard Bureau began an initiative to create and deploy twelve CBRNE Enhanced Response Force Package (CERFP) units, patterned after the Marine Corps' CBRIF.

**Office of the Special Assistant to the Secretary of Defense
for Chemical and Biological Defense and Chemical
Demilitarization Programs (DATSD[CB&CDP])**

3010 Defense Pentagon

Washington, DC 20301-3010

<http://www.acq.osd.mil/cp/index.html>

The SA(CB&CDP) falls under the assistant to the secretary of defense for nuclear and chemical and biological defense programs (ATSD[NCB]), who reports to the undersecretary of defense for acquisition, technology and logistics (USD[AT&L]). Formerly a deputy assistant to the secretary of defense, this office acts as the single focal point within the Office of the Secretary of Defense responsible for oversight, coordination, and execution of the DoD CB Defense Program and chemical demilitarization program (between 2001 and 2005, the chemical demilitarization program had a separate oversight office). This office develops the DoD Annual Report to Congress on CB Defense in addition to providing other related reports and testimonies to congressional committees. These reports can be accessed at the DATSD website.

Office for Domestic Preparedness (ODP)

810 Seventh Street, NW

Washington, DC 20531

(800) 368-6498

<http://www.ojp.usdoj.gov/odp/>

The Office for Domestic Preparedness was originally the program office within the Department of Justice responsible for enhancing the capability of state and local jurisdictions to respond to and mitigate the consequences of incidents of domestic terrorism, with a focus on CB incidents. Attorney General Janet Reno established this office in 1998 to develop and administer training and equipment assistance programs for state and local response agencies. In October 1999, it assumed the 120-city training program initiated by the DoD in 1997. The office was transferred to DHS in 2003. The agency provides grants to states and local jurisdictions, providing hands-on training through a number of residential training facilities and in-service training at the local level, funding and working with state and local jurisdictions to plan and execute exercises, and providing technical assistance onsite to state and local jurisdictions.

**Organization for the Prohibition of Chemical
Weapons (OPCW)**

2517 JR

The Hague

The Netherlands

+31(70) 416-3300

<http://www.opcw.org/>

The OPCW, an independent organization working in the interests of its member states, is charged with implementing the provisions of the Chemical Weapons Convention in order to achieve the vision of a world both free of chemical weapons and in which cooperation in chemistry for peaceful purposes for all is fostered. More than 175 member states have now signed the CWC. The headquarters proposes policies for implementing the Convention to the member states, and it develops and delivers programs with and for them. These programs include efforts to ensure a credible, transparent regime to verify the destruction of chemical weapons and prevent their reemergence; to provide protection and assistance against chemical weapons; to encourage international cooperation in the peaceful uses of chemistry; and to bring about universal membership of the OPCW by facilitating international cooperation and national capacity building.

Pine Bluff Arsenal

Commander, U.S. Army Pine Bluff Arsenal

ATTN: AMSSB-OPB-RMSP

10020 Kabrich Circle

Pine Bluff, Arkansas 71602-9500

(870) 540-3000

<http://www.pba.army.mil/>

Pine Bluff Arsenal was established in 1941 to load incendiary bombs and chemical munitions. For a short time in the 1950s and 1960s, it was the site of a biological weapons production plant, and in the 1980s, of a binary chemical weapons production facility. Today it is the second largest stateside chemical weapons stockpile site, and it continues to fill smoke and white phosphorus munitions. It also rebuilds and repairs protective masks, fabricates and tests CB filters, and provides other maintenance functions for CB defense equipment.

Technical Support Working Group (TSWG)

Arlington, Virginia

http://www.tswg.gov/tswg/cbrnc/cbrnc_ma.htm

The TSWG is a national forum that identifies, prioritizes, and coordinates interagency and international research and development requirements specifically for combating terrorism. The group works under the auspices of the State Department, with work in the ten subgroups coordinated by DoD, DoJ, DHS, and DOE technical chairs. The subgroups seek out industry and government research and development efforts that can be quickly turned around and fielded, usually within two years. One of the subgroups, co-chaired by the FBI and the intelligence community, focuses on CBRN countermeasures. Its products are usually similar to, but not as rugged as, the military's CB defense equipment.

U.S. Air Force Materiel Command

Public Affairs Office

4375 Chidlaw Road, Building 262

Wright-Patterson Air Force Base, Ohio 45433

(937) 257-6308

<http://www.afmc.wpafb.af.mil/>

Because the DoD CB Defense Program is a joint research and development program, there are Air Force agencies that coordinate and integrate their CB defense efforts with Army, Navy, Marine Corps, and other defense agencies. The Air Force's main advocates for CB defense are the Nuclear and Counterproliferation Office under Air and Space Operations and the Office of the Civil Engineer under Air Force Installations and Logistics, both stationed in the Pentagon. The counterproliferation office focuses on policy and strategy, while the civil engineer office focuses on coordinating the development of equipment and concepts to respond to a CB weapons attack against an air base.

A number of laboratories under the Air Force Materiel Command execute research and development for CB defense under the oversight of the JPEO-CBD. The Air Force Research Laboratory offices at Wright-Patterson Air Force Base and Tyndall Air Force Base are home to the primary Air Force researchers, while others work at the Human Systems Group at Brooks Air Force Base. The Air Force Civil Engineer Support Agency at Tyndall Air Force Base and the Air Force Operational Test and Evaluation

Command at Kirkland Air Force Base also participate in developing and evaluating CB defense equipment.

U.S. Air Force Counterproliferation Center (CPC)

325 Chennault Circle

Maxwell Air Force Base, Alabama 36112

(334) 953-2119

<http://www.au.af.mil/au/awc/awcgate/awc-cps.htm>

The CPC is hosted by the Air University at Maxwell Air Force Base and funded to undertake and direct counterproliferation research and education. This includes assessing NBC and missile proliferation threats and the means of addressing these threats as well as research and education on related topics as appropriate. The CPC hosts research projects, organizes Air Force CP conferences, sets up a CP speakers series and a CP information depository and clearinghouse, publishes books and occasional papers, provides CP courses and briefings for senior officers, and provides CP curriculum and faculty development support to the Air University.

U.S. Army Chemical Materials Agency (CMA)

4585 Parrish Road

Building E

Aberdeen Proving Ground, Maryland 21010-4005

(410) 436-3629

<http://www.cma.army.mil/>

The DoD established a program manager for chemical demilitarization in 1985 to dispose of the 31,500 tons of chemical agents and munitions located at nine chemical weapons stockpiles. This office has gone through a number of reorganizations and titles, the latest title being the Chemical Materials Agency (CMA). CMA is responsible for the safe storage of chemical agents and munitions as well as for the construction of the disposal facilities at each site and execution of the disposal process in line with environmental and health safety regulations. Its mission was to complete disposal within the CWC deadline of April 2007, but congressional insistence on use of untested "alternative technologies" other than incineration has extended that deadline possibly to beyond 2012. The CMA website describes the organization and its mission but is primarily a tool to reach out to the

public and communicate issues relating to the chemical stockpile sites.

U.S. Army Chemical School and Center (USACMLS)

320 MANSCEN Loop

Fort Leonard Wood, Missouri 65473-8929

(573) 563-8053

<http://www.wood.army.mil/usacmls/>

The Chemical School is the Army's center for doctrine, organization, training, equipment, and leader development for the Chemical Corps. In addition to providing military NBC defense capabilities for the warfight and homeland security, the Chemical Corps provides the Army with smoke, obscurant, and flame capabilities. The Air Force, Navy, and Marine Corps also have training detachments located at Leonard Wood. The Chemical Defense Training Facility allows students to enter an actual toxic agent environment as a confidence measure to assure that the protective ensembles, the detectors, and the decontaminants do work. In 2005, the Chemical School broke ground on a facility designed to train first responders to react to a terrorist CB incident. This facility should be operational in 2007.

U.S. Army Medical Research Institute for Chemical Defense (USAMRICD)

3100 Ricketts Point Road

Aberdeen Proving Ground, Maryland 21010-5400

(410) 426-3628

<http://chemdef.apgea.army.mil/>

USAMRICD is a subordinate organization of the Army's Medical Research and Materiel Command at Fort Detrick, Maryland. Its mission includes researching and developing medical countermeasures to CW agents and training medical personnel in the medical management of chemical casualties. Although its name dates back to 1981, the Edgewood-based organization has been responsible for developing medical chemical defense capabilities since 1922 under other names.

U.S. Army Medical Research Institute for Infectious Diseases (USAMRIID)

1425 Porter Street

Fort Detrick, Maryland 21702-5011

<http://www.usamriid.army.mil/>

USAMRIID, also a subordinate organization under the Army's Medical Research and Materiel Command, conducts research to develop strategies, products, information, procedures, and training programs for medical defense against both BW threats and naturally occurring infectious diseases that require special containment. Its research covers all medical countermeasures, vaccines, and drugs used by the military for BW defense, and it has one of only two laboratories in the country with the capability to study highly hazardous viruses at Biosafety Level 4 (BL-4), or maximum biological containment. The other BL-4 suite is at the CDC in Atlanta, Georgia. Currently, a biodefense medical campus is being built to allow the USAMRIID, NIAID, and DHS to cooperatively research and develop medical countermeasures for homeland security.

U.S. Army Nuclear and Chemical Agency (USANCA)

7150 Heller Loop

Suite 101

Springfield, Virginia 22150-3198

(703) 806-7870

USANCA's mission is to provide expert technical support and assistance to Army elements worldwide and to other U.S. government agencies and NATO agencies engaged in NBC programs. This includes managing a NBC weapons effects database, establishing NBC contamination survivability standards, and participating in international standardization of NBC defense matters. Its experts also work on chemical surety matters and support the Army's Chemical Stockpile Emergency Preparedness Program.

U.S. Army Research Laboratory (ARL)

Swan Creek Inn

Building 2207

Aberdeen Proving Ground, Maryland 21005

(410) 278-5964

<http://www.arl.army.mil/slاد/Services/Chem-Bio-new.html>

ARL is the Army's corporate basic and applied research laboratory, tasked to provide innovative science, technology, and analy-

sis to enable full-spectrum operations. Its Survivability and Lethality Analysis Directorate conducts much of the research required to determine NBC contamination survivability standards and to develop data that permit the Army to construct equipment resistant to CB weapons effects and the corrosive nature of decontaminants.

U.S. Army Technical Escort Unit (TEU)

ATTN: AMSSB-OTE-PAO

5183 Blackhawk Road

Aberdeen Proving Ground, Maryland 21010-5424

(410) 436-6455

The Army's TEU provides the DoD and other federal agencies with a unique, immediate, and global response capability for CB warfare material. This includes sampling, detection and monitoring, rendering-safe, packaging, escorting, and disposing of the material, be it a leaking chemical munition, a terrorist device, or a battlefield weapon. Originally formed in 1944 to escort U.S. chemical weapons to and from the United States, TEU now supports a wide host of agencies with its CB munitions and material expertise during peace and war, including responding to the threat of CB terrorism at national special security events and evaluating, rendering safe, and transporting unburied CB munitions. In October 2004, the unit was reflagged as the 22d Chemical Battalion (TEU) under the 20th Support Command (CBRNE).

U.S. Naval Surface Warfare Center

17320 Dahlgren Road

Dahlgren, Virginia 22448-5100

(540) 653-8531

<http://www.nswc.navy.mil/>

The U.S. Navy has a small but active group of agencies that routinely participate in the DoD CB Defense Program. The Navy's advocate for CB defense is the director for Surface Warfare (N76) under the chief of Naval Operations, located in the Navy Yard in Washington, DC. Three components—the Naval Sea Systems Command, the Naval Air Systems Command, and the Naval Facilities Engineering Command, develop and promote the Navy's sea, air, and ground CB defense requirements, respectively. The Naval Surface Warfare Center is the main Navy laboratory conducting research and development for CB defense under the

JPEO-CBD's oversight. Other supporting agencies include the Naval Air Warfare Center, the Naval Research Laboratory, and the Naval Medical Research Center under the Navy's Bureau of Medicine and Surgery. The Marine Corps, as a component of the Navy, has no independent laboratories, but does have personnel who manage several research and development programs under JPEO-CBD oversight in the U.S. Marine Corps Systems Command in Quantico, Virginia.

U.S. Northern Command (NORTHCOM)

250 Vandenberg Street, Suite B-016
Peterson Air Force Base, Colorado 80914-3808
(719) 554-6889
<http://www.northcom.mil/>
<http://www.jtfcs.northcom.mil/>

NORTHCOM began operations in 2002 to provide command and control of DoD homeland defense and to coordinate defense support of civil authorities. Specifically, this mission includes the conduct of operations to deter, prevent, and defeat threats and aggression aimed at the United States, its territories, and interests, and (as directed) provide defense support of civil authorities including consequence management operations. NORTHCOM has control over the Joint Task Force for Civil Support (JTF-CS), which would plan and integrate DoD support to the lead federal agency (FBI or FEMA) in the federal response to a terrorist CBRN incident. This support could include incident site support, casualty medical assistance and treatment, civilian disaster preparedness and displaced populace support, mortuary affairs support, logistics support, and air operations.

U.S. Special Forces Command (SOCOM)

Public Affairs Office
7701 Tampa Point Boulevard
MacDill Air Force Base, Florida 33621
(813) 828-4600
<http://www.socom/mil/>

SOCOM has two distinct faces that the command portrays in its military operations—their “white operations” and their “black operations.” The “white operations” are its more public role, where the A-teams deploy to train foreign military soldiers on various peacekeeping and other military operations issues. There are also

those missions in which larger joint task forces composed of special forces operations support major combat operations, moving deep behind enemy lines to conduct aggressive searches for enemy leaders, watch enemy force deployments, or hunt out WMD delivery systems (such as mobile Scud launchers) or WMD storage sites. The "black operations" are those missions that the public usually does not hear about (at least right away): the rescue missions, counterterrorism missions, and WMD interdiction missions.

Following the Persian Gulf War in 1991, the Aum Shinrikyo Tokyo subway incident in 1995, and during the DoD's development of a counterproliferation initiative through the late 1990s, the SOCOM leadership identified the four capabilities to find, track, and neutralize an adversary's WMD program as one of their top priorities. SOCOM and the U.S. Strategic Command (STRATCOM) were the two defense leads in developing an overarching counterproliferation strategy with the Joint Staff J-5 directorate, a strategy that gradually developed into the current combating WMD strategy seen today.

U.S. Strategic Command (STRATCOM)

Public Affairs Office

901 SAC Boulevard, Suite 1A1

Offutt Air Force Base, Nebraska 68113-6020

(402) 294-4130

<http://www.stratcom.mil/>

STRATCOM was established in 1992 to manage the nation's strategic nuclear weapons strike capability, including all Air Force and Navy forces that have nuclear weapons. During the late 1990s, in response to DoD's direction to develop a counterproliferation strategy, STRATCOM and SOCOM led the drafting of such a strategy under the Joint Staff J-5 directorate's guidance. In 2002, the DoD announced it would merge the U.S. Space Command with STRATCOM, adding the responsibility of managing the DoD's strategic command, control, computers, intelligence, surveillance, and reconnaissance (C4ISR) resources. In 2003, STRATCOM's responsibilities grew to include managing missile defense integration and DoD information operations. In January 2005, Defense Secretary Donald Rumsfeld tasked STRATCOM with integrating and coordinating DoD's combating WMD capabilities, notably in the development of a WMD interdiction and a WMD elimination capability. STRATCOM has

developed a Combating WMD Center at DTRA to execute the day-to-day management of that responsibility.

Private Organizations

Arms Control Association (ACA)

1150 Connecticut Avenue, NW

Suite 620

Washington, DC 20036

(202) 463-8270

<http://www.armscontrol.org/>

The Arms Control Association (ACA) is a national nonpartisan membership organization dedicated to promoting public understanding of and support for effective arms control policies. Through its public education and media programs and its magazine, *Arms Control Today*, ACA provides policy makers, the press, and the interested public with authoritative information, analysis, and commentary on arms control proposals, negotiations and agreements, and related national security issues.

Carnegie Endowment for International Peace (CEIP)

Non-Proliferation Project

1779 Massachusetts Avenue, NW

Washington, DC 20036

(202) 483-7600

<http://www.carnegieendowment.org/npp/>

The CEIP is a private, nonprofit organization dedicated to advancing cooperation between nations and promoting active international engagement by the United States. Its focus is on public policy analysis of international politics. Its nonproliferation site offers research, analysis, and comments on the nation's programs, CB warfare agents, links to online resources, and recent news on CB warfare issues. John Cirincione is the director for nonproliferation at the center; he teaches at Georgetown University and is one of America's best-known weapons experts. The Endowment publishes *Foreign Policy*, one of the world's leading magazines on international politics and economics, reaching a readership in more than 120 countries.

Center for Biosecurity of University of Pittsburgh**Medical Center**

The Pier IV Building

621 E. Pratt Street, Suite 210

Baltimore, Maryland 21202

(443) 573-3304

<http://www.upmc-biosecurity.org/>

The Center for Biosecurity is an independent, nonprofit organization working to affect policy and practice in ways that lessen the illness, death, and civil disruption that would follow large-scale epidemics, whether they occur naturally or result from the use of a biological weapon. The Center's projects aim to provide independent, critical research and analysis for decision makers in government, national security, bioscience, medicine, public health, and private industry. Dr. Tara O'Toole, a medical doctor and member of several government advisory committees and expert bodies dealing with biodefense, is the chief executive officer and director for the center. The center offers a quarterly *Biosecurity Bulletin* on its site.

Chemical Corps Regimental Association (CCRA)

P.O. Box 437

Fort Leonard Wood, Missouri 65473

(573) 329-6566

<http://www.chemical-corps.org/>

The CCRA is an organization of military (active and retired) and civilian supporters of the Army Chemical Corps. Its purpose includes promoting the heritage, esprit, and professionalism of the Chemical Corps and soliciting donations and gifts of funds, materials, services, and artifacts for the Chemical Corps Museum. Members meet annually at the Worldwide Chemical Conference, held at Fort Leonard Wood, Missouri. The CCRA links the active duty military members of the Chemical Corps with its history.

Chemical Weapons Working Group (CWWG)

P.O. Box 467

Berea, Kentucky 40403

(859) 986-7565

<http://www.cwwg.org/>

The CWWG is a coalition of U.S. citizens formed to oppose the incineration of chemical weapons as an unsafe disposal method and to work with government officials to promote disposal technologies that do not rely on open emissions. Their group coordinates with a wide number of grassroots organizations in other states on the issue of chemical demilitarization.

Federation of American Scientists (FAS)

1717 K Street, NW

Suite 209

Washington, DC 20036

(202) 546-3300

<http://www.fas.org/main/content.jsp?formAction=325&projectId=4>

Founded in 1945 by scientists of the Manhattan Project, FAS is dedicated to the responsible and humanitarian use of science and technology. It is a nonprofit group engaging in analysis and public education on a broad range of science, technology, and public policy issues. The goal of the biological and chemical weapons security project is to raise awareness among scientists of their responsibility to prevent the misuse of their research and to promote public understanding of the real threats from biological and chemical weapons. It features current news and analysis on CB warfare issues as well as a comprehensive section discussing the CWC and BWC treaties.

Harvard-Sussex Program (HSP) on CB Weapons

Freeman Centre

University of Sussex

Brighton, East Sussex

BN1 9RF, United Kingdom

+44 (0) 1273 678 172

<http://www.susx.ac.uk/spru/hsp/index.html>

HSP is a long-standing collaboration between Harvard University in the United States and the University of Sussex in the United Kingdom. The program undertakes research, publication, and training in support of informed public policy on international CB warfare issues. Its aim is to promote the global elimination of CB weapons and to strengthen constraints against hostile use of biomedical technologies. HSP runs seminars, work-

shops, and colloquia to bring scholars and government officials together, in addition to its involvement in other international organizations such as the World Health Organization and the International Committee of the Red Cross. Its quarterly *CB Weapons Conventions Bulletin* is available online.

**Henry L. Stimson Center's
CB Weapons Nonproliferation and Response Project**
1111 19th Street, Suite 1200
Washington, DC 20036
(202) 223-5956
<http://www.stimson.org/cbw/>

The Stimson Center is a nonprofit, nonpartisan institution devoted to enhancing international peace and security through a combination of analysis and public outreach. Its work covers a range of topics, from the elimination of NBC weapons to roles and missions of the U.S. armed forces. Its CB Weapons Nonproliferation and Response Project examines a wide range of topics to include arms control, CB terrorism, and general CB weapons issues, not restricted merely to the United States. The project issued a *CB Weapons Chronicle* discussing events in these areas, but new reports have not been released since 2003.

**Monterey Institute of International Studies'
CB Weapons Nonproliferation Program (CBWNP)**
460 Pierce Street
Monterey, California 93940
(831) 647-4154
<http://cns.miis.edu/cns/projects/cbwnp/index.htm>

The CBWNP monitors the global proliferation of CB weapons and develops strategies for halting and reversing their spread. The program's research focuses on understanding why states and subnational groups are motivated to acquire CB weapons, as well as efforts to implement the 1993 Chemical Weapons Convention and to strengthen the 1972 Biological Weapons Convention. Its products include reports on current CB weapons issues and nonproliferation treaties, country CB warfare capabilities, a database of terrorist incidents involving CB warfare materials, and in-depth case studies of the terrorist acquisition and use of CB weapons.

National Academies of Sciences (NAS)

500 Fifth Street NW
Washington, DC 20001
(202) 334-2000
<http://www.nas.edu/>

The NAS is a private, nonprofit society of distinguished and independent scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. The National Research Council is the main agency under the NAS that advises Congress on the chemical demilitarization program and the CB defense program, although the NAS's Institute of Medicine often can be involved in particular CB defense-related issues. Its reports are available to the public online and through the National Academy Press.

National Defense Industrial Association (NDIA)

2111 Wilson Boulevard
Arlington, Virginia 22201-3061
(703) 522-1820
<http://www.ndia.org/Template.cfm?Section=Divisions>

The NDIA is an advocacy group of more than 1,200 companies from the entire spectrum of defense and national industrial bases, including organizations that sell goods and services to the various government agencies of the United States' executive branch. The group provides a legal and ethical forum for the interchange of ideas between the government and industry to resolve industrial problems of joint concerns, such as research and development, procurement, and logistics support. There is a CB defense division within NDIA that coordinates meetings between government, industry, and academia to exchange information and constructive counsel on current CB defense topics.

NBC Industry Group

P.O. Box 2781
Springfield, Virginia 22152
<http://www.nbcindustrygroup.com/>

The NBC Industry Group is composed of more than 140 companies, not-for-profit organizations, and consultants who support NBC defense activities. Their purpose is to provide information

on NBC civil and military matters to the U.S. military forces, other appropriate agencies of the United States, and the general public. Its statement of purpose also includes improving understanding of the importance of NBC defense and its contributions to the ability of the United States to carry out its global responsibilities. This group meets monthly to discuss NBC defense issues with various government and industry representatives, exchanging information on current events in this area and discussing emerging trends and requirements. They are not lobbyists but are a collection of interested business members with a common goal of maintaining an adequate industrial capability in this area.

Nuclear Threat Initiative (NTI)

1747 Pennsylvania Avenue, NW 7th floor
Washington, DC 20006
(202) 296-4810
<http://www.nti.org/>

Ted Turner and former Senator Sam Nunn founded the NTI in January 2001. This organization's mission is to strengthen global security by reducing the risk of use and preventing the spread of nuclear, biological, and chemical weapons. It accomplishes this through increasing public awareness, promoting studies in particular program areas, and investigating areas that governments could execute on a larger scale. The website includes a research library with information on CB warfare issues, a tutorial on weapons of mass destruction, and a newswire dedicated to providing daily news on NBC weapons, terrorism, and related issues.

Stockholm International Peace Research Institute (SIPRI)

Signalistgatan 9
SE-169 70 Solna, Sweden
+46-8-655 97 00
<http://www.sipri.org/contents/cbwarfare/>

SIPRI is an international research foundation, established in 1966, that examines questions of conflict and cooperation toward international peace and security, with the aim of contributing to an understanding of the conditions for peaceful solutions of international conflicts and for a stable peace. It supports several research areas, including arms control, export controls, military expenditures and technology, and, of course, CB weapons. Its CB

Warfare Project is one of SIPRI's longest running programs, focusing on all developments regarding CB weapons, including efforts to establish effective and equitable disarmament regimes, allegations of their use, and measures to stem their proliferation and prevent their use by terrorist and criminal organizations.

9

Print and Nonprint Resources

There are many resource materials about chemical and biological warfare and related issues but only a limited number of recent books available on this topic. Many publishers see CB warfare as a specialty field and not an issue of interest to the general public; unfortunately, there is not a great variety of books available, but there are several very good ones out there. There were three general "surges" in literary publications corresponding with increased public interest: one following the Dugway Proving Ground incident in 1968, one during the military's campaign to develop binary chemical weapons in the 1980s, and one recently with the interest in biological terrorism caused by the anthrax-tainted letters in 2001. Certainly more books are available on various CB warfare topics than are listed here, especially on such specific issues as bioterrorism, the World War II accidental release of mustard agent into the port at Bari, Operation Ranch Hand, and others. The following list is focused more on the general topic of CB defense and CB terrorism rather than on specific issues.

A few journals and magazines, newsletters, and government documents may be obtained on request through the right channels. The Government Accountability Office, for instance, has a wide variety of documents available at no cost through the Internet. Most of the journals and newsletters listed below tend to focus on current issues, but they often touch on historical background material.

The real blessing for those interested in this subject is the World Wide Web, with its variety of information sources on CB warfare, weapon systems, and pictures of defense equipment. A

great deal of information on the industries associated with CB defense programs can be found on the Internet, for instance. There is some repetition of information on particular issues, the sources may not be entirely objective, and some cross-checking of facts may be necessary before these sources can be used, but those are the risks one takes with information on the Internet. Chapter 8 listed several Internet sites associated with particular agencies; the websites listed below are not associated with major CB defense agencies but have well-developed information sources.

Books and Journal Articles

Alibek, Ken, with Stephen Handelman. *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World. Told from Inside by the Man Who Ran It*. New York: Random House, 1999.

Ken Alibek defected to the United States in 1992 after reaching the post of deputy chief of Biopreparat, the Soviet Union's offensive biological weapons research and development program. His narrative covers the mid-1970s to the early 1990s, discussing the enormous scope of the Soviet Union's offensive BW program and its views and interactions with the United States. Of particular interest is his firsthand account of the Sverdlovsk anthrax outbreak that occurred in 1979. The book is a mesmerizing glimpse inside a true mass destruction program.

Brophy, Leo P., and George J. B. Fisher. *The Chemical Warfare Service: Organizing for War*. Washington, DC: Office of the Chief of Military History, 1959.

The Army's history office wrote a number of books after World War II to record its efforts; they are often called the "Army green books" because of their covers. This volume, the first of a three-part history of the Chemical Warfare Service, relays a great number of technical, organizational, and historical facts relating to the Service's leadership, organization, and programs executed during World War II. The first volume starts with the origins of the Chemical Warfare Service, its mission and roles during World War I and the interwar period, its development and continued growth through World War II, and continues with discussion of

its field units, personnel management, and the training of chemical specialists, general soldiers, and civil defense officers.

Brophy, Leo P., Wyndham D. Miles, and Rexmond Cochrane. *The Chemical Warfare Service: From Laboratory to Field*. Washington, DC: Office of the Chief of Military History, 1966.

This is the second of three books in the Army's historical collection on the Chemical Warfare Service's work during World War II. The volume covers the research, development, procurement, and distribution of chemical warfare materiel. It also starts with research and development efforts undertaken in World War I and through the interwar period, and discusses the toxic agents, incendiaries, smoke generators, and flame throwers manufactured during this time as well as the protection equipment developed and fielded to the soldiers. It discusses in detail the industrial mobilization and procurement actions taken as well as transportation and storage issues. There is not much mention of the U.S. Army's offensive BW program (much of which was still classified when the book was written), but there is a great deal of information on the development and use of chemical defense equipment, smoke generators, and incendiary munitions.

Brown, Frederic J. *Chemical Warfare: A Study in Restraints*. Westport, CT: Greenwood Press, 1981.

This book was originally published in 1968 but has been reprinted because of recent high demand. Whereas the Army's "green books" focused on military developments during World War II, Brown's book covers CW policy issues from World War I into the interwar period and through the end of World War II. His book provides perhaps the most thorough coverage of American CW military policy during this period, even to the present. This review discusses the military's and political leadership's views and positions rather than technical points, intending to develop in the reader an understanding of the restraints that prevent the employment of chemical weapons during military conflicts.

Bryden, John. *Deadly Allies: Canada's Secret War, 1937-1947*. Toronto: McClelland and Stewart, 1989.

Unknown to most people, Canada played a major role in the United States' and United Kingdom's CB warfare program during

World War II. This included developing anthrax and botulinum toxin as weaponized agents and conducting open-air CW trials at Suffield, Canada's parallel to Dugway Proving Ground. Although the Canadian program was much smaller in scale, this book offers a unique view into the U.S. and British CB warfare programs that has not been seen elsewhere.

Cirincione, Joseph, Jon Wolfsthal, and Miriam Rajkumar. *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 2nd ed. Washington, DC: Carnegie Endowment for International Peace, 2005.

This well-researched book summarizes the nuclear, biological, and chemical weapons histories and current weapons programs and capabilities of various nations, including Russia, China, France, the United Kingdom, the United States, India, Pakistan, Israel, North Korea, and Iran. The emphasis is more on these countries' nuclear programs and does not speculate about undeclared chemical or biological weapons programs. The authors also discuss what they call "nonproliferation successes" including Libya, Iraq, former Soviet states, Argentina, Brazil, and South Africa. The section on Iraq is particularly of interest, with equal discussion on what the U.S. government thought was there and what was later found (or, in this case, not found).

Clarke, Robin. *The Silent Weapons: The Realities of Chemical and Biological Warfare*. New York: David McKay, 1968.

Clarke's book is similar to a number of others written in this time, at the height of the U.S. CB warfare program and during the rise of environmental awareness movements. The book is very technically focused on the properties of CB warfare agents, but it also offers a historical review. There is a discussion on the potential employment of modern CB warfare agents and the use of herbicides in Vietnam.

Cole, Leonard A. *Clouds of Secrecy: The Army's Germ Warfare Tests over Populated Areas*. Totowa, NJ: Rowman & Littlefield, 1988.

Leonard Cole's first book on CB weapons tests undertaken by the U.S. military focuses on the open-air simulant tests executed in the United States during the 1950s and 1960s, including tests in

Minneapolis, New York City, and San Francisco. He calls into question the legitimacy of the tests, the safety of the simulants used, and the U.S. government's lack of warning to the public. He examines the resurgence of the U.S. CB warfare program in the 1980s with a concern that such testing will be resumed in light of alleged Soviet threats.

Cole, Leonard A. *The Eleventh Plague: The Politics of Biological and Chemical Warfare*. New York: W. H. Freeman, 1997.

This book jumps across three main topics: open-air and human volunteer testing conducted in the 1960s that may have threatened the health and safety of the public, the military challenges posed by Iraq during the Gulf War with an interesting review of Israel's civil defense effort, and the future challenges nations face from BW terrorism and the continued proliferation of BW programs. Cole also discusses the challenges in developing a verifications protocol for the BWC.

Cordesman, Anthony. *The Challenge of Biological Terrorism*. Washington, DC: Center for Strategic and International Studies, 2005.

The author takes on the issue of bioterrorism by viewing how the government conducts risk assessments in this area, examines the probability of low-level biological attacks as well as less probable mass casualty attacks, and discusses how the government ought to develop policies and programs to address the threat. Although this is a short book, it is well-footnoted and drives its points home in bulleted recommendations.

Cordesman, Anthony and Abraham R. Wagner. *The Lessons of Modern War*, Vol. 1, *The Arab Israeli Conflicts, 1973–1989*; Vol. 2, *The Iran-Iraq War*; and Vol. 3, *The Afghan and Falklands Conflicts*. Boulder, CO: Westview Press, 1990. Vol. 4, *The Gulf War*. Boulder, CO: Westview Press, 1996.

Although these books are not focused on CB warfare, they include excellent reviews of CB warfare threats and employment along with the discussions of the particular conflicts. These reviews includes analyses of when and where CB warfare agents were allegedly used, what weapon systems delivered the agents, defensive measures taken, and the overall impact of CB warfare

in each conflict. Cordesman's book on the Iran-Iraq War includes an excellent account of the CW incidents that occurred during that conflict, unparalleled in other books on the war. It has similar details on what occurred during the Gulf War in terms of CB warfare concerns and preparations.

Covert, Norman M. *Cutting Edge: A History of Fort Detrick, Maryland, 1943-1993*. Fort Detrick, MD: Public Affairs Office, 1993.

Although this book could easily be overlooked as strictly a government public relations release and therefore biased, it relates a good history of the post and its programs (BW-related and otherwise) since its inception in 1943. The book describes the various military activities located on Fort Detrick, its past commanders, and other relevant data. Photographs help illustrate the major facilities and former research efforts executed at the post, including the famous "8-ball" where the Army tested weaponized BW agents.

Croddy, Eric, with Clarisa Perez-Armendariz and John Hart. *Chemical and Biological Warfare: A Comprehensive Survey for the Concerned Citizen*. New York: Copernicus Books, 2002.

This is one of the most comprehensive and modern books written for the layman to date on CB warfare. Croddy covers threat agents and weapon systems; the countries that are developing these weapons; a brief history of CB warfare events, arms control, and disarmament issues; and CB terrorism. Even given the large area he covers, the author offers a practical and solid review of all the issues for readers who lack a military background.

Dando, Malcolm. *Biological Warfare in the 21st Century: Biotechnology and the Proliferation of Biological Weapons*. London: Brassey's, 1994.

The author discusses research and development of BW agents and technologies, with some historical inputs, and leads into how one might execute nonproliferation efforts in the future. There is not much focus on military applications, but this book is very good reading for information on BW agents, research technologies, and arms control issues.

Douglass, Joseph D., and Neil C. Livingstone. *America the Vulnerable: The Threat of Chemical/Biological Warfare*. Lexington, KY: Lexington Books, 1987.

This book describes the proliferation of CB warfare agents and potential use by the Soviet Union and non-state actors through a series of vignettes and discussions on the issues. The authors emphasize the deadly nature of the threat and the need to implement actions—such as increased intelligence gathering, response teams, and arms control measures—to reduce vulnerability to the threat.

Drell, Sidney, Abraham Sofaer, and George D. Wilson, eds. *The New Terror: Facing the Threat of Biological and Chemical Weapons*. Stanford: Hoover Institution Press, 1999.

The editors of this book have compiled the presentations of more than twenty noted experts in technical, legal, military, social, and medical issues associated with the threat of CB weapons. The scholars, practitioners, and government officials met at the Hoover Institution to discuss CB weapons issues in November 1998, but the subjects are still pertinent and interesting. Although the reading may prove complex for some, these views offer a unique perspective on the challenges associated with dealing with these unconventional weapons.

Falkenrath, Richard A., Robert D. Newman, and Bradley A. Thacher. *America's Achilles Heel*. Cambridge, MA: MIT Press, 1998.

This book discusses the possibilities of both state and non-state actors using NBC weapons in covert and terrorist applications. It attempts to answer the basic questions of the known record of attempts to acquire or use NBC weapons and what factors explain the character and frequency of past NBC weapons use. This book is more an examination of policy of dealing with NBC weapons proliferation than a technical or historical review of NBC weapons per se.

Gilbert, Martin. *The First World War: A Complete History*. New York: Henry Holt, 1994.

Although many books on World War I overlook or minimize the role of gas attacks, Gilbert's book has a good deal of information on various CW attacks and the impact of chemical warfare during

this period. His book puts chemical warfare into perspective as a constant hazard that was dealt with as a matter of fact rather than as an extraordinary condition of warfare. Other books, such as Liddell Hart's *A History of the World War* and S. L. A. Marshall's *World War I*, also cover chemical warfare well in their discussions of military operations during this war.

Haber, Ludwig Fritz. *The Poisonous Cloud: Chemical Warfare in the First World War*. New York: Oxford University Press, 1986.

Ludwig Haber is the son of Fritz Haber, the Nobel laureate and lead scientist for the German military's CW effort during World War I. Although written largely from the German perspective, the author's objective and frank findings are extremely valuable in understanding the true impacts of chemical warfare during that period, minus the propaganda that has been spun about its use during the war since then. This book is perhaps the best source book on chemical warfare during World War I. It is not in print now but is available through a print-on-demand program.

Harris, Robert, and Jeremy Paxman. *A Higher Form of Killing: The Secret Story of Chemical and Biological Warfare*. New York: Hill and Wang, 1982.

This book offers a critical look at the development of CB weapons, focusing mostly on the period between 1940 and 1980, with an opening chapter on World War I. Written by British authors, the book offers a good account of the offensive CB warfare research carried out by the United States and United Kingdom during and after World War II. The authors' perspectives lean toward demonstrating that although CB weapons are indiscriminate terror weapons, attempts to rid the world of these weapons have somehow failed.

Hart, Liddell. *A History of the World War*. Boston: Little, Brown, 1935.

Hart's book on World War I (originally published in 1930) is an excellent, very complete account of the origins of this war and of the many battles fought on land and sea. Although it has few maps and no photos, the author more than makes up the deficit with his unblinking assessments of the triumphs and failures on both sides. He is one of the few authors who objectively assessed

the use and impact of chemical weapons during the conflict. What instantly won me over was the following passage: "The chlorine gas originally used was undeniably cruel, but no worse than the frequent effect of shell or bayonet, and when it was succeeded by improved forms of gas both experience and statistics proved it the least inhumane of modern weapons. But it was novel and therefore labeled an atrocity by a world which condones abuses but detests innovation."

Heller, Charles. *Chemical Warfare in World War I: The American Experience, 1917-1918*. Washington, DC: Government Printing Office, 1984.

Major Heller wrote this study at Fort Leavenworth to show how the Army prepared for chemical warfare as the United States entered World War I and how the American Expeditionary Force adapted (or failed to adapt) to fighting in the first war that featured chemical warfare on a mass scale. Well illustrated with numerous maps, sketches, and tables, this book shows the difference being prepared for chemical warfare can make, as the unprepared and untrained Americans quickly adapted to fight and win in this war. This is definitely the one book to read if one is looking for the American CW experience in World War I. Available online at <http://www-cgsc.army.mil/carl/resources/csi/csi.asp#papers>.

Hogg, Ian V. *Gas*. New York: Ballentine Books, 1975.

This book is a set of the Ballentine's Illustrated History of the Violent Century, Weapons Book number 43. In addition to covering the chemicals, weapon systems, and organizations developed for chemical warfare in World War I, the book contains probably the largest collection of photographs of both sides' personnel using defensive gear and offensive weapons. The text is short but accurate, and the photographs more than make up for the book's brevity.

Howard, Russell, and Reid Sawyer, eds. *Terrorism and Counterterrorism: Understanding the New Security Environment*. Guilford, CT: McGraw-Hill, 2003.

This collection reprints a number of articles from prominent journals, starting with chapters defining terrorism and why groups

use this tactic, modern terrorism practices, the role of religion, terrorist use of weapons of mass destruction, and other issues. On the counterterrorism side, the editors have chapters discussing strategies and approaches for combating terrorism, instruments of counterterrorism, and organizing to fight terrorism. The topics in this collection offer the reader a very diverse but well-researched and enjoyable set of discussions on a wide range of terrorism-related issues.

Jane's NBC Protection Equipment. Alexandria, VA: Jane's Information Group, 1988- .

Jane's military books are well known for their international coverage of equipment and current military issues. Their NBC protection equipment books, updated annually, are equally renowned as the source books to go to for summaries and photographs of existing CB defense equipment used by militaries all over the world. The book covers military and commercial detection, protection, decontamination, and medical CB defense equipment, with details on their use, sizes and weights, and manufacturers.

Journal of the American Medical Association, 278, no. 5 (August 6, 1997).

This particular issue of *JAMA* has ten contributions from military and civil medical experts that deal with biological warfare and biological terrorism cases. Although *JAMA* features occasional articles on medical CB warfare issues throughout its issues, this particular issue is well worth digging out of the past-issues catalogue and reading. It includes historical summaries of the U.S. offensive BW program as well as commentaries on the nature of particular BW agents.

Kleber, Brookes E., and Dale Birdsell. *The Chemical Warfare Service: Chemicals in Combat.* Washington, DC: Office of the Chief of Military History, 1966.

This, the third volume of the Army's historical collection on the Chemical Warfare Service's work during World War II, is devoted to its overseas activities, including administration, logistics, and combat operations. Each theater had a distinct command-and-control function and a distinct emphasis on particular aspects of the Chemical Warfare Service's products. The Mediter-

anean theater of operations had some large-area smoke operations and made heavy use of the chemical mortars firing high explosives in support of combat operations. The European theater of operations saw heavy use of large-area smoke screens but also saw the chemical mortars supporting combat operations. In the Pacific, there was less interest in smoke operations but more use of flame throwers and mortars. The book discusses specific employment of chemical units at specific battles in each theater. In all theaters, there were considerable preparations against the potential Axis employment of CB weapons.

Lavoy, Peter R., Scott Sagan, and James J. Wirtz, eds.. *Planning the Unthinkable: How New Powers Will Use Nuclear, Biological, and Chemical Weapons*. Ithaca, NY: Cornell University Press, 2000.

This book features a diverse collection of essays on current countries developing offensive NBC weapons and what their motivations are. Countries discussed include Iraq, Iran, Israel, India, Pakistan, and North Korea. Also discussed are terrorist groups in general. The tone of the articles is more on the side of counter-proliferation policy, trying to fathom what drives these countries and what the U.S. government's response should be.

Lederberg, Joshua, ed. *Biological Weapons: Limiting the Threat*. Cambridge, MA: MIT Press, 1999.

Lederberg, a Nobel Laureate, has collected a number of technical, historical, and arms control-oriented essays on the issue of biological warfare. In addition to a historical review, the essays discuss arms control, Iraq's biological warfare program, detection and employment of BW agents, and policies for responding to the threat of biological warfare. The articles address both the possibilities of nations employing biological weapons and terrorists employing biological hazards. The introduction is written by former Defense Secretary William Cohen.

Leitenberg, Milton. *Assessing the Biological Weapons and Bioterrorist Threat*. Carlisle: U.S. Army Strategic Studies Institute, December 2005.

Leitenberg is a long-time arms control expert in the field of chemical-biological weapons and part of the team that created

the 1970s SIPRI series "The Problem of Chemical and Biological Warfare." His monograph takes the U.S. government to task over its excessive preoccupation with bioterrorism, a preoccupation that the author believes is not only unjustified by any threat assessments but actually increasing the danger of terrorist BW incidents due to all the constant concern voiced by the government. This very well-researched paper is available online at <http://www.strategicstudiesinstitute.army.mil/pdffiles/PUB639.pdf>.

Lefebure, Victor. *The Riddle of the Rhine*. New York: Chemical Foundation, 1923.

This book, written during the arms control talks between the world wars, focuses mostly on the German industry that produced the chemicals and the German forces that employed them. The book's thesis is to identify what it took to develop the capability for chemical warfare, and therefore what is required to disarm a nation that potentially has this capability. The book is dated and obviously slanted against the German manufacturers, but it is a readily available text with good information about World War I agents and munitions.

Lewis, William H., and Stuart E. Johnson. *Weapons of Mass Destruction: New Perspectives on Counterproliferation*. Washington, DC: National Defense University Press, 1995.

The National Defense University often hosts symposia addressing challenges to U.S. national security, and in particular, NBC weapons and missiles as a means of delivery. This particular symposium featured several military and civilian experts discussing a range of issues from nonproliferation incentives and disincentives to how to protect against proliferation when it occurs. The book has fifteen such discussions and concludes with a proposal on how nations might prevent future proliferation and craft policy to implement these decisions.

Marshall, S. L. A. *World War I*. New York: Houghton Mifflin, 2001.

Marshall's book on World War I, first printed in 1964, stands out as one of the most thorough and analytical reviews of this conflict. It is a very readable history, well illustrated with maps throughout, of a very complex conflict and (more important for

the reader of this book) it does not shrink from descriptions of the use of CW agents. One of the more famous photos of British soldiers, blinded by mustard agent but moving toward the aid station, is included in the book. Although the details of the chemical attacks are not as complete as one might wish, the author clearly demonstrates how the use of chemicals was merely another tool of war, used often and by both sides.

Mauroni, Albert J. *America's Struggle with Chemical-Biological Warfare*. Westport, CT: Praeger, 2000.

This book focuses on the development of U.S. military and national policy associated with CB warfare between 1968 and 1990, including discussions of the Army's technical developments, both offensive and defensive, during this time frame. One chapter of the book discusses the Dugway Proving Ground sheep incident of 1968, noting the Army's side of the story instead of the more popular and repeated versions of the press's view of events during that time. The book touches on current events, such as the Persian Gulf War, the chemical demilitarization program, and the DoD Domestic Preparedness Program that trained city emergency responders to deal with CB terrorism incidents.

Mauroni, Albert J. *Chemical-Biological Defense: U.S. Military Policies and Decisions in the Gulf War*. Westport, CT: Praeger, 1998.

This book discusses the Army's preparations and execution of CB defense for the coalition forces during the Persian Gulf War. It examines the Army leadership's deliberations in the Pentagon, at Aberdeen Proving Ground, and at Fort McClellan and the preparations of its forces in the Gulf. While the Army was unprepared going into the Gulf in August 1990, it was far better prepared in February 1991 when it started the ground offensive into Kuwait. The book also includes a chapter discussing the Khamisiyah depot incident in which it counters the popular view that military forces were exposed to nerve agents.

Mauroni, Albert J. *Chemical Demilitarization: Public Policy Aspects*. Westport, CT: Praeger, 2003.

Most publications discussing the Army's chemical demilitarization program focus on the technologies and the struggles between

the Army and its critics in light of leaks and accusations of insufficient safety measures. This book takes a public policy review of the program, examining how the Army developed its program starting in 1972, how the Army dealt with Congress and its critics, and how the Army could better execute chemical demilitarization and CB defense programs with the public and Congress, given a more appropriate public policy approach.

Mauroni, Albert J. *Where Are the WMDs? The Reality of Chem-Bio Threats on the Homefront and the Battlefield*. Annapolis: Naval Institute Press, 2006.

The fundamental understanding of what constitutes a "weapon of mass destruction" began to change in the mid-1990s, as the U.S. government began to become more concerned about the threat of terrorist CBRN incidents. The anthrax letter incidents in 2001 and the Iraq war in 2003 caused many to begin questioning whether the threat of "WMD" events was even valid for chemical or most biological warfare threats. This book walks through the government's CB defense actions from the mid-1990s through the Gulf War and poses ideas on how one ought to view the threat of CB weapons—not as WMDs but rather as unique and unconventional weapons.

McDermont, Jeanne. *The Killing Winds: The Menace of Biological Warfare*. New York: Arbor House, 1987.

This book takes a critical look at the U.S. CB defense program in the 1980s, when the rapid influx of funds into the CB warfare program was seen by critics as a resurgence of military plans to develop an offensive program. In her review of current events, the author interviews people on both sides of the issues, military leaders as well as critics of the military's program. Issues covered include the Sverdlovsk incident in 1979, the "yellow rain" investigations, the Japanese BW research during World War II and the U.S. military's recruitment of Japanese scientists, open-air chemical weapons testing, and other controversial topics.

Miller, Judith, Stephen Engelberg, and William Broad. *Germs: Biological Weapons and America's Secret War*. New York: Simon & Schuster, 2001.

This book grew out of a number of investigative reports for the *New York Times* that began in 1998, focusing on national prepara-

tions for BW defense from the 1970s through the 1990s. It touches on arms control issues, the Persian Gulf War, domestic BW terrorism, and what actions the government, at the highest levels, has taken (or not taken) to date. The authors portray a good sense of how the senior U.S. political and military leadership has dealt with biological warfare.

Norris, John, and Will Fowler. *NBC: Nuclear, Biological and Chemical Warfare on the Modern Battlefield*. Cambridge: Brassey's, 1997.

This short book summarizes basic facts on nuclear weapon effects and CB agents and illustrates modern (and primarily British) NBC protective systems. While very brief on BW information, the book includes chemical structures for most CW agents and explains how military personnel use their defensive equipment.

Palazzo, Albert. *Seeking Victory on the Western Front: The British Army and Chemical Warfare in World War I*. Lincoln: University of Nebraska Press, 2000.

The author makes a strong argument in this book that the British Army, when faced with the threat of chemical weapons, did not reluctantly initiate an offensive program, but rather recognized the need to incorporate these new weapons into its methods to reclaim the initiative. This book demonstrates how the British Army adapted its tactics to use a new technology and how this contributed to eventual victory.

Regis, Ed. *The Biology of Doom: The History of America's Secret Germ Warfare Project*. New York: Henry Holt, 1999.

Regis describes the technical work conducted for the offensive BW program by the United States between 1940 and 1975. He covers the recruitment of Japanese scientists after World War II, the open-air and human volunteer trials, North Korean accusations in the 1950s, and CIA experiments. Because the book focuses on incidents in which the military was widely criticized, one might think this author had a bias against the military program, but he portrays both sides well.

Rothschild, J. H. *Tomorrow's Weapons: Chemical and Biological*. New York: McGraw-Hill, 1964.

After leaving the Army Chemical Corps, Brigadier General (retired) J. H. Rothschild wrote this book in an attempt to explain to the general public the strategic military policies behind the U.S. offensive CB warfare program. The book outlines the weapons, tactics, and rationale for developing these weapons, one of which was to allow the United States to retain an ability to win against superior forces without resorting to nuclear weapons.

Schneider, Barry R. *Future War and Counterproliferation: U.S. Military Responses to NBC Proliferation Threats*. Westport, CT: Praeger, 1999.

This book examines the threat of NBC weapons and outlines how the United States could develop an effective counterproliferation strategy to reduce the threat from adversaries armed with NBC weapons and missiles. It has ample examples using such nations as Iraq, North Korea, Syria, and Libya, includes a full discussion of CB defensive measures, and is well-footnoted.

Seagrave, Sterling. *Yellow Rain: A Journey through the Terror of Chemical Warfare*. New York: M. Evans, 1981.

Seagrave's book surfaced during the national debate on binary weapons. The author notes both the increased CW activity of the Soviet Union in Laos and Afghanistan and the increased U.S. interest in binaries. During this discussion, he reviews the history of CB warfare with a particular focus on the 1968-1980 period.

Spiers, Edward. *Chemical Warfare*. Urbana: University of Illinois Press, 1986.

———. *Chemical Weaponry: A Continuing Challenge*. New York: Macmillan, 1989.

———. *Chemical and Biological Weapons: A Study of Proliferation*. New York: St. Martin's Press, 1994.

This trilogy of books offers a very complete discussion about the nature of modern chemical warfare, the doctrine and employment of chemical weapons, and the difficulties in trying to stop the proliferation of these weapons. The author discusses these complex issues at a level that is understandable to the general public without omitting critical facts. The first book presents a

good summary of CB warfare issues during World War I and II prior to delving into an examination of Soviet and NATO programs and policies during the Cold War. The last book has one of the earliest public analyses of CB defense preparations by the coalition allies during the Persian Gulf War.

Stockholm International Peace Research Institute (SIPRI). *The Problem of Chemical and Biological Warfare*. New York: Humanities Press, 1971–1975.

SIPRI's six-volume work on CB warfare is perhaps the most complete technical source of unclassified data on the subject up to the mid-1970s. The books may be hard to find, but they are a great source on the subject with a focus on Cold War offensive CB warfare programs across the globe. A CD-ROM version is available from the organization through its Internet site. In addition to a complete history, this set has data on CB weapons, legal aspects, current (as of the mid-1970s) national programs, arms control issues, and defensive measures.

Tucker, Jonathan, ed. *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*. Cambridge: MIT Press, 2000.

This collection features an in-depth review of terrorist incidents, from 1946 to 1998, that included the potential or actual use of CB hazards, including the Aum Shinrikyo incident of 1995. The author notes that there are far fewer cases of CB terrorism than would seem to justify the robust response that governments have raised to this threat. Tucker notes that although technical hurdles of producing and disseminating these agents may have been overcome, it is unclear what would motivate a terrorist group to actually employ CB agents.

Tucker, Jonathan. *War of Nerves: Chemical Warfare from World War I to Al Qaeda*. New York: Pantheon Books, 2006.

The title of the book is almost misleading as the author largely follows the discovery of nerve agents in the 1930s through the Cold War, through Middle East conflicts, through the Gulf Wars and including Aum Shinrikyo's use of, and al Qaeda's interest in, nerve agents. Although the author does start in World War I, his purpose is to set a basis for discussing the German research and

development of nerve agents prior to World War II. Tucker goes into great detail about the German work conducted during World War II, the subsequent arms race between the United States and the Soviet Union, and the Soviet Union's development of fourth-generation chemical warfare agents. Tucker unfortunately is not very sympathetic to the U.S. military's efforts and in more than one case uses inaccurate sources to explain the military's motives. Although Tucker does not discuss many CW agents other than nerve agents, his chapters on World War II and the Cold War era have information perhaps never published prior to this date, and the book is worth owning just for those data.

Vilensky, Joel, and Pandey Sinish. *Dew of Death: The Story of Lewisite, America's World War I Weapon of Mass Destruction*. Indianapolis: Indiana University Press, 2005.

Despite the very flowery and overly dramatic title, this book is actually a very solid academic study on the discovery and development of the one CW agent that, although weaponized by several countries, has never been used in combat. Lewisite was named after its inventor, Captain Winford Lee Lewis, an ordnance officer who had been attempting to design a CW agent similar to mustard agent but more suited for offensive operations. Vilensky tracks the Army's research, development, and stockpiling of lewisite through the decades and up to the destruction of lewisite stockpiles. This book is interesting not just because of the topic but for how the author describes the work conducted through the years, illustrating the way the United States developed, tested, stockpiled, and disposed of its CW agents.

Waite, Alden H. *Gas Warfare*. New York: Duell, Sloan and Pearce, 1942.

Brigadier General Alden Waite, then the second-highest ranking Chemical Warfare Service officer at the time this book was published, wrote it to educate the public and the military forces on CW issues as the nation was heading into a global war. The book includes a detailed discussion of CW agents, chemical weapons and their use in battle, and protection and first aid both for military and civil defense purposes. Although dated, the book offers a perspective of how the U.S. Army intended to use chemical weapons and to defend against them in World War II.

Wheelis, Mark, Lajos Rozsa, and Malcolm Dando, eds. *Deadly Cultures: Biological Weapons since 1945*. Cambridge: Harvard University Press, 2006.

This book sets out to address three central issues: Why have nations begun and in some cases continued to acquire biological weapons? Why have some nations terminated their BW programs? How have these nations demonstrated to the world that these programs are indeed terminated? The authors offer very detailed histories of BW programs initiated by the United States, the United Kingdom, Canada, France, the Soviet Union and its Warsaw Pact allies, Iraq, and South Africa. Other authors discuss anti-crop and anti-animal BW program efforts, incapacitant programs, allegations of BW use, terrorist BW cases, and political and legal issues related to biological warfare. While presenting more of an arms control perspective, this book is well written in addressing important policy issues regarding unconventional weapons.

Journals, Bulletins, and Newsletters

In addition to the journals, bulletins, and newsletters cited below, please recall that there are several journals and newsletters associated with the organizations listed in chapter 8.

Armed Forces Journal, McLean, VA
8201 Greensboro Drive
Suite 611
McLean, Virginia 22102
<http://www.afji.com/>

This monthly journal is not focused solely on military CB defense issues, but it does from time to time feature articles and commentaries associated with current national and international military CB defense issues. It is more likely to be in a military library than in the neighborhood library. The journal has recently begun posting its magazine articles online.

Army Chemical Review
320 MANSCEN Loop

Suite 210

Fort Leonard Wood, Missouri 65473-8929

<http://www.wood.army.mil/chmdsd/>

The *Army Chemical Review* is the official publication of the Army Chemical Corps, offering articles and information about ongoing CB defense issues within the military. It is published twice a year. It is also available online, after briefly being removed because of security concerns. It can be ordered through the Government Printing Office.

Bulletin of the Atomic Scientists

6402 South Kimbark

Chicago, Illinois 60637

<http://www.thebulletin.org/index.htm>

This arms control journal is more focused on nuclear weapon arms control, but occasionally it discusses CB warfare arms control issues. It is available through subscription and in some libraries.

The CBIAC Newsletter

Building E-3330

P.O. Box 196

Aberdeen Proving Ground, Maryland 21010-0196

<http://www.cbiac.apgea.army.mil/awareness/newsletter/intro.html>

The CBIAC Newsletter is a quarterly newsletter that includes articles on current events and recent news in the CB defense community as well as listings of contract awards and upcoming conferences. It is available through subscription as well as online, and past issues are available online.

The CBW Chronicle

Henry L. Stimson Center

11 Dupont Circle, NW

Ninth Floor

Washington, DC 20036

<http://www.stimson.org/cbw/?sn=cb20011221166>

This quarterly online chronicle reviews current domestic and international events in the CB defense community, chemical demilitarization programs, and CB arms control issues. Since its pri-

mary scholar Amy Smithson departed in 2003, the chronicle has not been active, but past issues remain online.

The CBW Conventions Bulletin

Harvard-Sussex Program
Science and Technology Policy Research
Freeman Centre, University of Sussex
Brighton
East Sussex
BN1 9QE, United Kingdom
<http://www.sussex.ac.uk/Units/spru/hsp/>

Each issue of this quarterly bulletin, available by subscription with past issues available online, includes arms control articles with a detailed summary of articles on CB defense and arms control issues that appeared in newspapers in the preceding quarter.

The CPC Outreach Journal

U.S. Air Force Counterproliferation Center
325 Chennault Circle
Maxwell Air Force Base, Alabama 36112
<http://www.au.af.mil/au/awc/awcgate/awc-cps.htm>

This bi-weekly journal recaps U.S. news articles on counterproliferation issues, including CB defense issues. It is distributed through an electronic mail subscription list. To join it, contact Ms. Jo Ann Eddy at the above website.

Homeland Defense Journal

4301 Wilson Boulevard
Suite 1003
Arlington, Virginia 22203

The *Homeland Defense Journal* seeks to facilitate communication among all levels of government concerned with homeland security, covering the issues and technology, solutions, policies, people, case studies, and events affecting that community. The magazine does address planning and response to terrorist CB incidents in addition to other disaster and incident management issues. Its online journal is available on subscription, but some of its featured articles are available without charge at its website.

Journal of Homeland Security

Analytic Services, Inc.

2900 South Quincy Street

Arlington, Virginia 22206

<http://www.homelandsecurity.org/newjournal/>

The Homeland Security Institute hosts an online journal that prints original articles from subject-matter experts on counter-proliferation, terrorism, and homeland security. The Institute also features a weekly newsletter summarizing recent news articles and upcoming events.

Military Medical Technology

1300 Piccard Drive, Suite 200

Rockville, Maryland 20850

(301) 926-5090

This commercial journal focuses on issues relating to the military medical profession, with each issue (available online) including an interview with the generals, admirals, and civilian authorities tasked to supply the U.S. military with equipment and strategies to protect the fighting force. Many of its issues focus on CB defense medical issues.

National Defense

2111 Wilson Boulevard

Suite 400

Arlington, Virginia 22201-3061

<http://www.ndia.org/>

This monthly journal is not focused solely on CB defense but often has industry and military perspectives on CB defense issues and equipment. Like the *Armed Forces Journal*, it is probably not in the neighborhood library but should be in many military libraries.

NBC International

Defence Division

Surrey House Corporate Communication

91 High Street

Esher, Surrey

KY10 9QA, United Kingdom

+44 (0) 1372 460111

<http://www.defenceinternational.co.uk/nbc/>

This magazine is published quarterly and is focused on both international military and civil sectors. It is devoted to the problems and threats that the world faces from weapons of mass effect, toxic industrial chemicals, and other CBRN-related issues. Its articles feature interviews with U.S. military CB defense experts and discussions on homeland security as well as military operations. It is a free publication available by ordering through its website.

Government Documents and Agency Publications

Center for Technology and National Security Policy. *Coping with an Attack: A Quick Guide to Dealing with Biological, Chemical and "Dirty Bomb" Attacks.*

This colorful, easy-to-read poster can be hung on bulletin boards in military and civilian offices, allowing individuals to understand the immediate actions necessary in the event of a terrorist CBRN incident. Available online at http://www.ndu.edu/ctnsp/wmd_tipsheet.htm.

Chemical Casualty Care Office. *Medical Management of Chemical Casualties*, 3rd ed. Aberdeen Proving Ground, MD: U.S. Army MRICD, 2000.

This pocket-sized book is, not surprisingly, a reference book for medical professionals who might have to deal with CW casualties. For each of the modern CW agents, there is a historical summary, a listing of signs and symptoms, toxicity information, and detection and protection methods. Available online at <https://cc.apgea.army.mil/products/info/products.htm>.

Chemical Warfare Review Commission. *Report of the Chemical Warfare Review Commission*. Washington, DC: Government Printing Office, 1985.

In compliance with congressional direction, President Ronald Reagan tasked the Chemical Warfare Review Commission to review the need for binary chemical weapons. Its report covers a good deal of U.S. policy on the justification for a retaliatory

chemical weapons capability and also gives a good history of the U.S. military stockpile.

Department of Defense. *DoD Annual Report to Congress on CB Defense* (March 2004). Washington, DC: Office of the Secretary of Defense, April 2005.

The publication of this annual report is a congressional requirement (and law under 50 US Code 1523). It reviews the current DoD management structure, research and development activities, logistics readiness, training, and CWC compliance measures. Reports between 1997 and today are available online at <http://www.acq.osd.mil/cp/index.html>.

Department of Defense. *Plan for Integrating National Guard and Reserve Component Support for Response to Attacks Using Weapons of Mass Destruction*. Washington, DC: Office of the Secretary of Defense, 1998

This report, prepared by a DoD "WMD Tiger Team" led by Brigadier General Roger Schultz, documents the efforts of the Army in its proposal to develop a reserve component force that would support the consequence management response to CB terrorism. Initially called Rapid Assessment and Initial Detection (RAID) elements, this concept would eventually take shape as the National Guard's WMD Civil Support Teams. Available online at <http://www.defenselink.mil/pubs/wmdresponse/>.

Department of Defense. *Proliferation: Threat and Response*. Washington, DC: Office of the Secretary of Defense, January 2001.

This publication identifies those nations suspected of sponsoring offensive CB warfare programs and the DoD's planned nonproliferation and counterproliferation responses to this threat. This is the last of a series of DoD proliferation reports. Available online at <http://www.defenselink.mil/pubs/ptr20010110.pdf>.

Department of Defense. *Quadrennial Defense Review Report*. Washington, DC: Office of the Secretary of Defense, February 2006.

The Quadrennial Defense Review (QDR) report outlines the DoD defense strategy and how the Department plans to reshape its forces and doctrine to execute the strategy. The 2006 report in

particular emphasized the combating WMD threat. Available online at <http://www.defenselink.mil/qdr/>. Also see the 2001 QDR on-line at <http://www.defenselink.mil/pubs/qdr2001.pdf>.

Department of Defense. *Report of the Defense Science Board Task Force on Persian Gulf War Health Effects*. Washington, DC: Defense Science Board, 1994.

The Defense Science Board was asked to review information regarding the possible exposure of people to CB weapons and other hazardous material during the Persian Gulf War and its aftermath. The board found no evidence that either chemical or biological weapons were used against U.S. service members, nor could it find epidemiological evidence of any coherent "syndrome." Available online at <http://www.acq.osd.mil/dsb.persianhealth.pdf>.

Department of Defense. *Strategy for Homeland Defense and Civil Support*. Washington, DC: Government Printing Office, 2005.

Written long after the president's *National Strategy for Homeland Security* (see below), this document detailed the Defense Department's plans for defending the United States and its territories from direct attacks by both nation-states and terrorist groups. The plan is to develop an active, layered defense that addresses threats in forward regions, approaches to the United States, and the homeland. It spells out the responsibilities and strategies to be used, to include providing critical capabilities to support the federal response to CBRN terrorist incidents.

Government Accountability Office (GAO). *Chemical and Biological Defense: Emphasis Remains Insufficient to Resolve Continuing Problems*. Washington, DC: GAO, March 1996.

———. *Chemical and Biological Defense: Improved Risk Assessment and Inventory Management Are Needed*. Washington, DC: GAO, September 2001.

———. *Chemical and Biological Defense: Observations on DoD's Risk Assessment of Defense Capabilities*. Washington, DC: GAO, October 2002.

———. *Chemical and Biological Defense: Observations on Non-medical Chemical and Biological R&D Programs*. Washington, DC: GAO, March 2000.

Chemical and Biological Defense: Units Better Equipped, but Training and Readiness Reporting Problems Remain. Washington, DC: GAO, November 2000.

———. *Chemical Warfare: DoD's Successful Effort to Remove U.S. Chemical Weapons from Germany.* Washington, DC: GAO, February 1991.

———. *Chemical Weapons: DoD Does Not Have a Strategy to Address Low Level Exposures.* Washington, DC: GAO, September 1998.

———. *Chemical Weapons: FEMA and Army Must Be Proactive in Preparing States for Emergencies.* Washington, DC: GAO, August 2001.

———. *Chemical Weapons and Materiel: Key Factors Affecting Disposal Costs and Schedule.* Washington, DC: GAO, February 1997.

———. *Combating Terrorism: DoD Efforts to Improve Installation Preparedness Can Be Enhanced with Clarified Responsibilities and Comprehensive Planning.* Washington, DC: GAO, August 2004.

———. *Combating Terrorism: Need for Comprehensive Threat and Risk Assessments of Chemical and Biological Attacks.* Washington, DC: GAO, September 1999.

———. *Combating Terrorism: Need to Eliminate Duplicate Federal Weapons of Mass Destruction Training.* Washington, DC: GAO, March 2000.

———. *Weapons of Mass Destruction: DoD's Actions to Combat Weapons Use Should Be More Integrated and Focused.* Washington, DC: GAO, May 2000.

Congress has asked the GAO to review the DoD CB Defense Program, chemical demilitarization program, and other related topics many, many times. These reports and others are good tools for summarizing particular aspects of the DoD's programs at particular points in time. Although I do not always agree with their recommendations, the data are very good. All unclassified reports are available online at <http://www.gao.gov/>.

Joint Publication 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*. Washington, DC: Joint Chiefs of Staff, 2000.

Joint Publication 3-11 offers the official joint doctrine and concepts of operation for how the military as a whole intends to survive and sustain combat operations in a CB-contaminated environment. This document is updated every three to five years. Available online at http://www.dtic.mil/doctrine/jel/new_pubs/jp3_11.pdf.

Joint Publication 3-26, *Homeland Security*. Washington, DC: Joint Staff, 2005.

This publication provides joint doctrine to guide the armed forces in the conduct of homeland security, describing the framework, mission areas, missions and related supporting operations, and enabling activities. This includes discussion of the federal response to terrorist WMD incidents. Available online at http://www.dtic.mil/doctrine/jel/new_pubs/jp3_26.pdf.

Joint Publication 3-40, *Joint Doctrine for Combating Weapons of Mass Destruction*. Washington, DC: Joint Chiefs of Staff, 2004.

This joint publication sets forth the principles by which to plan for and conduct operations for combating weapons of mass destruction, including nonproliferation, counterproliferation, and consequence management operations. This publication complements the joint doctrine promulgated in Joint Publication 3-11 (above). Available online at http://www.dtic.mil/doctrine/jel/new_pubs/jp3_40print.pdf.

Jollenbeck, Lois, Lee Zwanziger, Jane Durch, and Brian Strom, eds. *The Anthrax Vaccine: Is It Safe? Does It Work?* Washington DC: National Academy Press, 2002.

The National Academy of Sciences' Institute of Medicine prepared this congressionally mandated report for the DoD to review the efficacy and safety of the currently licensed anthrax vaccine. This book describes in detail how the disease works, how the vaccine works, and how the DoD research measures up to the charges of its critics.

Kortepeter, Mark, George Christopher, Ted Cieslak, Randall Cullpepper, Robert Darling, Julie Pavlin, John Rowe, Kelly McKee, and Edward Eitzen, eds. *Medical Management of Biological Casualties*, 6th ed. Fort Detrick: U.S. Army MRIID, 2005.

This softcover book is a pocket-sized reference tool for medical experts who might have to deal with casualties exposed to BW agents. Information includes BW agent histories, signs and symptoms, treatments and prophylaxis, and detection and protection measures. Available online at <http://www.usamriid.army.mil/education/bluebook.html>.

National Research Council (NRC). *Chemical and Biological Terrorism: Research and Development to Improve Civilian Medical Response*. Washington, DC: National Academy Press, 1999.

———. *Disposal of Chemical Munitions and Agents: A Report*. Washington, DC: National Academy Press, 1984.

———. *Evaluations of Chemical Events at Army Chemical Agent Disposal Facilities*. Washington, DC: National Academy Press, 2002.

———. *Recommendations for the Disposal of Chemical Agents and Munitions*. Washington, DC: National Academy Press, 1994.

The NRC has executed a large number of studies to review and recommend actions in relation to the Army's chemical demilitarization program, in addition to other chemical defense topics. The three NRC reports on demilitarization listed above are probably the more valuable ones that review the entire disposal program; there are other NRC reports on individual sites and projects within the disposal program as well. The report on CB terrorism discusses the requirements and materiel available to respond to CB terrorism incidents and is not just focused on medical response, as the title suggests. Most NRC reports can be accessed and ordered through the National Academy Press at <http://www.nap.edu/>. Sections of the newer books can be read online, offering readers a chance to see exactly what they are purchasing.

Presidential Advisory Committee on Gulf War Veterans' Illnesses. *Final Report*. Washington, DC: U.S. Government Printing Office, 1996.

Congress received this final report from a twelve-member panel of experts reviewing the government's response to veterans' complaints of postwar illnesses, the nature of these illnesses, and what health risks were in the Gulf to which veterans could have been exposed. The recommendations of this panel drove the formation of an OSD office for a special assistant for Gulf War illnesses and a host of continued studies into the various potential causes of Gulf War illnesses.

Program Manager for Chemical Demilitarization. *Chemical Stockpile Disposal Program: Final Programmatic Environmental Impact Statement*. Aberdeen Proving Ground, Maryland: U.S. Army, 1988.

Although this book is not online and probably not in many libraries, it is a great reference document. It exhaustively covers the chemical warfare agents and their effects, potential strategies and risks in disposing of the munitions and agents at the stockpile sites, and public responses to the draft environmental impact statement. Although the program has changed considerably since 1988, this report is essential reading for those wishing to understand the chemical demilitarization program.

Shuey, Robert. *Nuclear, Biological, and Chemical Weapons and Missiles: The Current Situation and Trends*. Washington, DC: Congressional Research Service, August 2001

This Congressional Research Service (CRS) report is a great unclassified source for identifying countries that are developing offensive CB warfare programs. Although short (only thirty-three pages), it has a good deal of information and analysis on these nations and what their programs mean to the United States. Its assessment notes that "although the potential scale of NBC warfare has diminished with the end of the Cold War, the number of countries or groups that could initiate a nuclear, biological, or chemical attack may be increasing." Available online at <http://www.cnie.org/NLE/CRS/abstract.cfm?NLEid=21578>.

Sidell, Frederick, Ernest Takafuji, and David Franz, eds. *Medical Aspects of Chemical and Biological Warfare*. Washington, DC: Office of the Surgeon General, 1997.

This book discusses the medical management of CB warfare casualties in considerable depth, drawing upon the knowledge of some of the most learned professionals in the United States. It includes historical overviews of CB warfare, descriptions of the threat agents and CB defense equipment, with numerous pictures and references. Although focused on medical issues, the book is very readable by the layman as well as the general military history enthusiast. Available online at <http://www.nbc-med.org/SiteContent/HomePage/WhatsNew/MedAspects/contents.html>.

U.S. Congress Office of Technology Assessment. *Proliferation of Weapons of Mass Destruction: Assessing the Risks*. Washington, DC: Government Printing Office, 1993.

This book reviews the nature of nuclear, biological, and chemical threats; what countries are developing these weapons; and what nonproliferation measures are available to reduce this threat. This book was written prior to the announcement of the DoD's Counterproliferation Initiative.

The White House. *National Strategy to Combat Weapons of Mass Destruction*. Washington, DC: Government Printing Office, 2002.

President George W. Bush released this national strategy, formerly known as NSPD-17, as his administration's approach to addressing the threat of weapons of mass destruction posed by nations and terrorist groups who might obtain WMDs from those nations. This strategy took the step of separating consequence management from the area of counterproliferation, largely to accommodate the suggestion that the approaches of both the DoD and the DHS in combating WMDs and responding to the threat of terrorist WMDs were similar enough that they could be combined.

The White House. *National Strategy for Homeland Security*. Washington, DC: Government Printing Office, 2002.
<http://www.whitehouse.gov/homeland/book/index.html>

This strategy was developed shortly after the 9/11 attack to provide the various federal agencies with one strategy and common definitions for the terms to be used in relation to homeland security. While focusing nearly entirely on the terrorist threat, the

strategy spends a good deal of emphasis on the threat of CBRN terrorist incidents.

Internet Information Sources

Anthrax At Sverdlovsk, 1979

The National Security Archive

<http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB61/>

The National Security Archive has collected several government reports identifying U.S. intelligence estimates on the accidental release of weaponized anthrax at the Soviet biological weapons facility in Sverdlovsk in 1979, where at least sixty-eight people died.

Army Field Manuals

GlobalSecurity.org

<http://www.globalsecurity.org/military/library/policy/army/fm/>

This site features links to a large number of Army field manuals, including the multiservice field manuals on NBC defense. As a caution to the reader, the older manuals printed prior to 2001 are numbered FM 3-3, FM 3-4, and so on. After 2000, the Army changed its numbering system and the new versions are numbered FM 3-11.3, FM 3-11.4, and so on.

Biological and Chemical Weapons Control

Federation of American Scientists (FAS)

<http://www.fas.org/main/content.jsp?formAction=325&projectId=4>

<http://www.fas.org/nuke/index.html/>

The FAS hosts this site to provide information on special weapon capabilities around the world, including current news and information on arms control agreements, delivery systems, military doctrine, associated organizations, and facilities.

Bioterror

NOVA

<http://www.pbs.org/wgbh/nova/bioterror/>

This PBS special was originally broadcast in November 2001, following three *New York Times* reporters as they investigated the history of biological warfare. The interviews with Bill Patrick and Ken Alibek, two former BW researchers, are fascinating.

Biowar: The Nixon Administration's Decision to End U.S. Biological Warfare Programs.

The National Security Archive

<http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB58/>

Through the Freedom of Information Act, the National Security Archive has acquired several documents from the Nixon library that center on the studies and recommendations leading up to President Nixon's announcement on November 25, 1969, to end the country's offensive BW program. The documents offer some great insights and background into that decision.

Chem-Bio Resource Center

Tempest Publishing

<http://www.chem-bio.com/resource/>

This publishing firm has gathered a good number of government documents from 1996 to 2000, when the DoD was executing its Domestic Preparedness Program and training city emergency responders on how to respond to terrorist CB incidents.

Chemical & Biological Weapons Resource Page

Center for Nonproliferation Studies

<http://cns.miis.edu/research/cbw/index.htm/>

The Center's web page contains links to books, news releases, reports, briefings, and other resources related to CB weapons arms control, specific country profiles, agent characteristics, CB warfare and defense concepts, chemical demilitarization, and CB terrorism and response.

Chemical and Biological Weapons Site

Center for Defense Information

<http://www.cdi.org/issues/cbw/>

CDI's website has several old links to articles and information on CB warfare, including information on the CWC and BWC and links to other agencies involved in this area.

Chemical Stockpile Emergency Preparedness Program

Oak Ridge National Laboratory

<http://emc.ornl.gov/CSEPPweb/FEMACSEPPHome.html>

This web site's purpose is to disseminate information and tools developed for the Army's Chemical Stockpile Emergency Preparedness Program (CSEPP). Although its products focus solely on preparation for and response to the possibility of a chemical accident or incident at an Army chemical weapons stockpile site, much of the information (such as sheltering in place) is applicable to chemical terrorism scenarios.

Chemical Warfare Agents and Associated Health Guidelines

U.S. Army Center for Health Promotion and

Preventive Medicine

<http://chppm-www.apgea.army.mil/hrarc/CAW/>

The online documents at this website present physical and chemical characteristics on CW agents. The site also features a very complete glossary of medical terminology associated with CW research.

DefenseLINK

Department of Defense

Anthrax Vaccine:

<http://www.anthrax.osd.mil/>

Arms Control Treaties:

<http://www.defenselink.mil/acq/acic/treaties/>

Smallpox vaccine:

<http://www.smallpox.army.mil/>

WMD Civil Support Teams:

<http://www.defenselink.mil/specials/destruction/>

These are the official DoD information sites on specific military CB defense topics. They are not updated often other than when official policy changes.

DeploymentLINK

Office of the Special Assistant for Military Deployments

http://www.deploymentlink.osd.mil/current_issues/shad/shad_intro.shtml/

When the Office of the Special Assistant for Gulf War Illnesses stopped its investigation and closed down, its personnel transferred to this new office and continued to focus on the health and welfare of military personnel during overseas deployments. This site includes fact sheets on the SHAD cases, which took place in the 1960s.

Dugway Proving Ground Registry of Atmospheric Survivors (RATS)

<http://www.dugway.net/>

This site addresses the potential health consequences to military personnel who participated in the U.S. Army's atmospheric testing of CBR warfare agents. There is a great deal of information on Dugway tests as well as human volunteer tests conducted in the 1950s and 1960s.

Frequently Asked Questions: Likelihood of Terrorists Acquiring and Using Chemical or Biological Weapons

The Henry L. Stimson Center

<http://www.stimson.org/cbw/?SN=CB2001121259>

Amy Smithson, formerly of the Stimson Center, lists common public questions on the issue of CB terrorism and offers her expert advice.

Gilmore Commission

RAND National Security Research Division

<http://www.rand.org/nsrd/terrpanel/>

Because of concerns that the United States was not sufficiently prepared for acts of CBRN terrorism, Congress directed the establishment of a panel of "private citizens" to assess the current capabilities for domestic response to terrorist acts that involved WMDs and to recommend appropriate policies and strategies for managing and mitigating the effects of such incidents. The commission, chaired by former Virginia governor James Gilmore, met several times between 1998 and 2003, generating five comprehensive reports discussing the issue of CBRN terrorism and the U.S. government's preparedness for such incidents, and outlining recommendations to improve that preparedness.

GulfLINK

Office of the Special Assistant for Gulf War Illnesses

<http://www.gulfink.osd.mil/>

This website is no longer updated by DoD, as the office has closed, but it remains accessible. It holds all the raw data as well as investigations into cases where there was a possibility that U.S. forces might have been exposed to CB weapons during the Gulf War. The information papers go into great detail on CB defense equipment as well as the exact events as documented from the personnel involved.

Homeland Defense

U.S. Army Edgewood Chemical and Biological Center

<http://www.ecbc.army.mil/hld/ip/reports.htm/>

Based on the work initiated in the late 1990s under the DoD Domestic Preparedness Program, the Army has several information products and reports related to developing response capabilities for emergency responders reacting to potential CB terrorist incidents.

How Biological and Chemical Warfare Works

How Stuff Works

<http://www.howstuffworks.com/biochem-war.htm>

This site is a short and simple tutorial on, well, how CB warfare works. The information on this page is good for younger audiences, people that just want the facts, and those with short attention spans.

Institute for Biosecurity

Saint Louis University School of Public Health

<http://www.bioterrorism.slu.ed/index.html>

This institution offers a fully accredited master of science degree in biosecurity. In addition, this website has several information sources on chemical, biological, and radiological terrorism.

Iraq and Weapons of Mass Destruction

National Security Archive

<http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB80/>

The National Security Archive has a very good collection of intelligence documents and offers analysis on key documentation related to the controversy over how the Bush administration interpreted information gathered about Iraq's alleged WMD program prior to the U.S.-led coalition's invasion of Iraq in March 2003.

Jim Placke's NBC Links

<http://www.nbc-links.com/>

This site, run by an active-duty chemical officer in his spare time, offers a very extensive list of connections to just about every CB warfare-related Internet site available, from news articles to military units to industry sources and private agencies that work in this line of business. It is perhaps one of the best-populated and current sites for finding links to any source of CB defense information on the net.

Last Battle of the Gulf War

PBS Frontline

<http://www.pbs.org/wgbh/pages/frontline/shows/syndrome/>

PBS's *Frontline* ran a special in January 1998 discussing Gulf War illness issues. This site features information on the series and discussions on the various aspects under investigation, including the possibility that chemical or biological warfare agents could have caused these illnesses.

National Homeland Security Knowledgebase

<http://www.twotigersonline.com/resources.html>

This site offers a long list of website links to agencies addressing homeland security issues, as well as links to chemical and biological terrorism topics, emergency preparedness, and other topics.

National Response Plan

Department of Homeland Security

[http://www.dhs.gov/dhspublic/interapp/editorial/
editorial_0566.xml/](http://www.dhs.gov/dhspublic/interapp/editorial/editorial_0566.xml)

The National Response Plan replaced the former Federal Response Plan in 2004. It outlines how federal agencies will respond to various emergencies in which the states call for federal

assistance, from natural disasters such as hurricanes to human-caused disasters such as very large hazardous material incidents. In the full version of the National Response Plan, one can find incident annexes on the federal government's policies and procedures to respond to a biological or chemical (under the oil and hazardous material incident annex) terrorist incident. In either case, the DoD would be a major supporter of the lead federal agency coordinating the federal response efforts.

Plague Wars

PBS *Frontline*

<http://www.pbs.org/wgbh/pages/frontline/shows/plague/>

This PBS *Frontline* special, airing in October 1998, focused on the growing threat of biological weapons. It includes a fascinating perspective on the rise and fall of the Soviet offensive BW program. This site features information on the series and frequently asked questions on the issue of biological weapons.

Public Health Emergency and Response

Centers for Disease Control and Prevention

Chemical warfare agents:

<http://www.bt.cdc.gov/chemical/>

Biological warfare agents:

<http://www.bt.cdc.gov/Agent/agentlist.asp/>

Chemical demilitarization:

<http://www.cdc.gov/nceh/demil/articles/safedisposal.htm/>

There are many references to health studies and information on the various CB hazards on the CDC site, in addition to those DHHS efforts to ensure that a government emergency response capability exists in the event of a biological terrorist event.

Preventing Biological Warfare

University of Bradford, UK

<http://www.brad.ac.uk/acad/sbtwc/>

This site focuses on BW arms control topics, including up-to-date reports on the conferences held by the BWC review group, the BWC protocol text, current issues, and ad hoc group working

papers. This site has an international rather than a U.S. government focus.

RAND Books and Publications

Rand Corporation

<http://www.rand.org/pubs/online/>

Although RAND is hardly the only major think tank engaged in national security studies, it does have a large number of well-written studies on chemical and biological terrorism available online at no charge.

Rocky Mountain Arsenal

Department of the Army

<http://www.rma.army.mil/>

Rocky Mountain Arsenal's past association with the development of chemical weapons often draws attention from the media and aspiring authors. This website reviews its history, the cleanup effort, and its plans to eventually become a national wildlife refuge.

Science.bio.org

Biotechnology Industry Organization

<http://science.bio.org/bwc.news.html>

This site features current news on bioterrorism and biodefense, conferences on biodefense, and various reports and links to organizations on this topic.

U.S. Air Force Counterproliferation Center

U.S. Air Force Air War College.

<http://www.au.af.mil/au/awc/awcgate/awc-cps.htm>

The Air War College hosts this site in the interest of advancing concepts relating to national defense. Although the briefings, reports, and links to agencies on this page are not officially sanctioned DoD products, they cut across the entire spectrum of nonproliferation and counterproliferation topics and can be a valuable source of information for both casual and serious students.

Weapons of Mass Destruction

GlobalSecurity.org

<http://www.globalsecurity.org/wmd/index.html/>

This site is organized for short narratives detailing information on nuclear, biological, and chemical weapon systems, to include links to past congressional hearings, news reports, and information about the Army's chemical and (former) biological weapons storage sites.



Glossary

ABCA American-British-Canadian-Australian

ABM Anti-Ballistic Missile treaty

Acetylcholinesterase An enzyme that hydrolyzes the neurotransmitter acetylcholine, which must be inactivated in order to terminate impulse transmissions at cholinergic synapses within the nervous system. The action of this enzyme is inhibited by nerve agents, which further cause continuous stimulation of the affected organ.

Active defense Measures taken to detect, divert, or destroy enemy NBC weapons and delivery means while en route to their targets.

Aerosol A liquid or solid composed of finely divided particles suspended in a gaseous medium. Examples of common aerosols are dust, mist, fog, and smoke. Particle size may vary from 0.01 micrometers to 100 micrometers.

Anthrax vaccine An inactivated vaccine made from protective antigen of organisms, approved by the FDA in 1970 for inhalation and percutaneous anthrax cases. The vaccine may be less effective if subject is faced with an overwhelming challenge of inhaled spores.

Antiterrorism Defensive measures used to reduce the vulnerability of individuals and property to terrorist acts, to include limited response and containment by local military forces.

Atropine A compound used as an antidote for nerve agents. It works by inhibiting the actions of excess acetylcholine in the parasympathetic nervous system (this action is more effective at muscarinic sites than at nicotinic sites).

Bacteria A class of single-celled microorganisms that live in soil, water, organic matter, or the bodies of plants and animals. Their complex structure allows them to reproduce on their own by cell division. Diseases caused by bacteria often respond to treatment with antibiotics.

BDO Battledress Overgarment

Binary chemical munition A munition designed to use two relatively nontoxic chemicals that combine and react during flight, producing a chemical warfare agent for release on target. The U.S. binary weapons were 155 mm GB-filled artillery rounds, VX-filled MLRS warheads, and VX-filled Bigeye bombs.

Biological warfare (BW) agent A living organism, or material derived from living organisms, that causes disease in personnel, plants, or animals, or causes the deterioration of materiel, the intentional use of which is to cause incapacitation or death; also known as "agents of biological origin."

Biological weapon An item of materiel that projects, disperses, or disseminates a BW agent including arthropod vectors (fleas, ticks, mosquitoes, and the like).

Blister agent A chemical agent that injures the eyes and lungs and irritates or blisters the skin and mucous membranes; also called vesicant agents. They are primarily nonlethal incapacitant and persistent agents but can cause death if a person is exposed to large amounts. Blister agents include mustard agent and lewisite.

Blood agent A chemical compound that affects bodily functions by preventing the normal utilization of oxygen by body tissues. They are primarily lethal and nonpersistent agents. Blood agents include cyanogen chloride and hydrogen cyanide.

BWC Biological and Toxins Weapons Convention

C4I Command, Communications, Control, Computers, and Information

Casualty Any person who is declared dead or is missing, ill, or injured.

Catastrophic incident Any natural or man-made incident, including terrorism, that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, or government functions.

CB Chemical and biological.

CBIRF Chemical-Biological Incident Response Force

CDC Centers for Disease Control and Prevention

Chemical, biological, radiological, and nuclear (CBRN) hazards Toxic chemical, biological, radiological, and nuclear hazards that may be employed by adversarial nations or non-state actors against U.S. forces or civilians, not necessarily in quantities that could cause mass casualties. CBRN hazards include those created from a release, other than attack, of toxic industrial chemicals (specifically toxic inhalation hazards), biological agents of operational significance, and radioactive matter as well as a result of deliberate employment of NBC weapons during military operations.

Chemical, biological, radiological, nuclear, and high-yield explosives (CBRNE) incidents An emergency resulting from the deliberate or unintentional release of nuclear, biological, radiological, or toxic or poisonous chemical materials, or the detonation of a high-yield explosive. This term is often used by antiterrorism personnel.

Chemical demilitarization The process of destroying chemical agents and munitions so that the CW agents cannot be reconstituted into their original lethal form. The U.S. program for eliminating chemical weapons includes the Chemical Stockpile Disposal Program (CSDP), the Non-Stockpile Chemical Material (NSCM) project, the Alternative Technology and Approaches Project (ATAP), and the Chemical Stockpile Emergency Preparedness Program (CSEPP). The Alternative Chemical Weapons Assessment (ACWA) program is also associated with the program, although not directly.

Chemical warfare (CW) agent Any toxic chemical agent intended for use in military operations for incapacitation or death of exposed personnel through its physiological effects. Riot control agents, herbicides, and incendiary munitions are chemical munitions but not considered toxic chemical agents.

Chemical weapon A munition or device specifically designed to disperse a CW agent with the intent to cause death or other harm.

Choking agents Chemical agents that cause irritation and inflammation of the breathing apparatus. They are generally lethal nonpersistent agents. Choking agents include chlorine, phosgene, and diphosgene.

CIA Central Intelligence Agency

Ciprofloxacin An antibiotic drug useful in treating bacterial infections. Ciprofloxacin has recently been cleared by the FDA for use by civilians exposed to anthrax spores as a result of BW terrorism. Another related antibiotic is doxycycline.

Civil support DoD support to civil authorities for domestic emergencies and for designated law enforcement and other activities. In this context, the DoD plans to use reconnaissance and decontamination chemical units and WMD Civil Support Teams to assist federal, state, and local emergency responders address the challenges of CBRN terrorist incidents.

Collective protection Protection provided to a group of individuals in a nuclear, biological, or chemical environment that provides a contamination-free working environment and permits relief from continuous wear of protective gear. Collective protection can be subdivided into stand-alone shelters and integrated systems (built into buildings and vehicles).

Confirmatory identification A process that will confirm or refine the presumptive identification of a BW agent. It is expected to occur at an analytical facility, as opposed to an emergency responder at the scene of

an incident. The purpose of confirmatory identification is to allow for the initiation of medical countermeasures.

Consequence management Measures taken to protect public health and safety, restore essential government services, and provide emergency relief to governments, businesses, and individuals affected by the consequences of a natural or man-made incident.

Contamination The deposit, absorption, or adsorption of chemical or biological agents or radioactive material on or by structures, areas, personnel, or objects.

Counterforce Operations that divert, deny, degrade, or destroy an adversary's capability to develop, manufacture, stockpile, or employ NBC weapons before they can be used.

Counterproliferation Activities across the full range of U.S. government efforts to combat proliferation, including the application of military power to protect U.S. forces and interests; intelligence collection and analysis; and support to diplomacy, arms control, and export controls—with particular responsibility for assuring that U.S. forces and interests can be protected should they confront an adversary armed with NBC weapons

Critical infrastructure Those systems and assets, whether physical or virtual, so vital to the United States that their incapacitation or destruction would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those areas.

CRS Congressional Research Service.

CST Civil Support Team

CWC Chemical Weapons Convention

CWS Chemical Warfare Service

Decontamination The process of making any person, object, or area safe by absorbing, destroying, neutralizing, ventilating, making harmless, or removing chemical or biological agents, or by removing radioactive material clinging to or around the affected entity. The military defines four levels: immediate decontamination for life-saving measures, operational decontamination to reduce the spread of contamination, thorough decontamination to allow the resumption of unprotected operations, and restoration decontamination to allow peacetime use of equipment and areas.

Detection Determination of the presence of a CBRN hazard but not necessarily the identification of its exact nature. Generally split into manual detection (requiring an operator) and automatic detection (running without operator assistance).

DHS Department of Homeland Security

DHHS Department of Health and Human Services

Dispersion The dissemination of agents in liquid or aerosol form within a specific area to maximize casualties.

DoD Department of Defense

DOE Department of Energy

DoJ Department of Justice

Emergency preparedness Planning activities undertaken to ensure that federal government resources are in place to support the president in a designated National Security Emergency (to include man-made or natural disasters).

Emergency responder Includes federal, state, local, and tribal emergency public safety, law enforcement, emergency response, emergency medical, and related personnel, agencies, and authorities.

EPA Environmental Protection Agency

Essential services Services such as tribal administration, public facilities, fire, police, public health, education, sewer, water, environmental and land use, transportation, and utility services that are deemed necessary to provide health and safety to the public.

False positive An erroneous detection indicating the presence of a CB warfare agent when one is not there, particularly due to interferents or other equipment malfunctions. A "false negative" would be the failure to detect and subsequently warn when a CB warfare agent is present, a much more dangerous condition than a false positive.

FBI Federal Bureau of Investigation

FDA Food and Drug Administration

FEMA Federal Emergency Management Agency

First responder Local police, fire, and emergency personnel who in the early stages of an incident are responsible for the protection and preservation of life, property, evidence, and the environment; such workers include those in emergency management, public health, clinical care, public works, and other skilled support personnel.

Force protection Actions taken to prevent or mitigate hostile actions against DoD personnel (including family members), resources, facilities, and critical information. These actions do not include measures to defeat the enemy or protect against accidents, weather, or disease.

Gas The molecular form of a substance in which molecules are dispersed widely enough to have little attraction to each other. "Gas" is also typically the slang form used to address all CW agents, although many CW agents are liquid or aerosols.

Hazardous material (1) Any material that is flammable, corrosive, an oxidizing agent, explosive, toxic, poisonous, etiological, radioactive, nuclear, unduly magnetic, a chemical agent, biological research material, compressed gases, or any other material that, because of its quantity, properties, or packaging, may endanger human life or property. (2) A substance or material determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce.

Homeland defense The protection of United States sovereignty, territory, domestic population, and critical infrastructure against external threats and aggression or other threats as directed by the president. The DoD is responsible for homeland defense. Protecting U.S. military installations and facilities from terrorists CBRN incidents is considered an aspect of homeland defense.

Homeland security A concerted national effort to prevent terrorist attacks within the United States, to reduce America's vulnerability to terrorism, and to minimize the damage and to recover from attacks that do occur. Homeland security is made up of the elements of homeland defense, civil support, and emergency preparations.

HPAC Hazard Prediction and Assessment Capability

Identification Determination of the exact identity of the CBRN hazard—for instance, sarin nerve agent as opposed to mustard agent, or anthrax as opposed to smallpox.

Immunization Administration of either a nontoxic antigen to confer active immunity or an antibody to confer passive immunity on a person or animal to render it insusceptible to toxic effects of pathogens or toxins.

Improvised nuclear device (IND) An illicit nuclear weapon bought, stolen, or otherwise originating from a nuclear state, or a weapon fabricated by a terrorist group from illegally obtained fissile nuclear weapons material that produces a nuclear explosion. An IND would result in catastrophic loss of life, destruction of infrastructure, and contamination of a very large area. If nuclear yield is not achieved, the result would likely resemble a radioactive dispersal device (RDD) in which fissile weapons material was dispersed locally.

Incapacitants In this context, chemical or biological warfare agents that temporarily disable personnel for hours to days after exposure has ceased, given a moderate and not excessive dosage. Examples of incapacitants include mustard agent, SEB toxin, psychochemicals, and riot control agents.

Individual protection Actions taken by individuals to survive and continue their mission under CBRN hazard conditions. Usually divided into nonmedical means (the use of individual protective equipment, such as suits and masks) and medical means (the use of prophylaxes and medical treatments).

Individual protective equipment (IPE) The protective ensemble worn by military personnel, including the protective jacket, trousers, boots, gloves, and mask; also known as personal protective equipment (PPE).

Investigational new drug (IND) Any new drug or biological product that is not formally approved by the FDA but may be administered to humans with FDA approval and the user's informed consent.

Isolation Forced separation of persons known to be ill or suspected of being infected from other persons, in such places, conditions, and time as will prevent transmission of an infectious agent. The intent of isolation is to protect healthy persons from becoming ill by restricting the movement of people showing signs and symptoms of infection.

JSLIST Joint Service Lightweight Integrated Suit Technology

Mass casualties A number of casualties produced in a relatively short period of time that overwhelms the available medical and logistical support capabilities. The federal response measure for mass casualties is 1,000 injured and/or dead.

Median lethal dosage of a liquid agent (LD₅₀) The dose that will cause death in 50 percent of an exposed population by routes of administration other than respiratory (often ingested or percutaneous). There are also incapacitating (nonlethal) doses (ID) and effective (first signs) doses (ED). Doses can also be expressed in terms that affect or kill 5 percent or 25 percent of those exposed. Often expressed in terms of milligrams of agent per kilograms of body weight.

Median lethal dosage of a vapor or aerosol (LC₅₀) The vapor or aerosol exposure necessary, in terms of concentration and time, to cause death in 50 percent of an exposed population. There are also incapacitating (nonlethal) concentrations (ICt) and effective (first signs) concentrations (ECt). Doses can also be expressed in terms that affect or kill 5 percent or 25 percent of those exposed. Often expressed in terms of milligrams of agent-minutes/cubic meters.

Miosis The contraction of the pupil of the eye, specifically when the pupil is unable to dilate and remains contracted, causing an effect similar to when the lights have suddenly dimmed. This effect can be caused by exposure to low levels of nerve agent vapors and can last from days to weeks, depending on the dose received.

Mission-oriented protective posture (MOPP) A flexible system of individual protective equipment providing the protection sufficient for a person can carry out his or her work depending on the existing threat levels, the mission, humidity, and temperature. In general, there are five levels of MOPP, from MOPP-0 (carrying protective gear) through MOPP-4 (wearing everything).

NBC contamination survivability The capability of a defense system and its crew to withstand an NBC-contaminated environment and relevant

decontamination without losing the ability to accomplish the assigned mission. There are three components: hardening the system against NBC warfare agents, hardening the system against the corrosive nature of decontaminants, and designing the system to ensure personnel wearing individual protective equipment can operate it.

Nerve agent A potentially lethal chemical agent that interferes with the transmission of nerve impulses by inhibiting the cholinesterase enzyme and elevating the acetylcholine level in the body. Nerve agents are often divided into the G-series, developed in the 1930s–1940s (tabun, sarin, soman), and the V-series, developed in the 1950s–1960s.

Nonpersistent agent A CW agent that, when released, dissipates and/or loses its ability to cause casualties after a relatively short period of time. These agents are primarily an inhalation hazard. They generally last as liquids for minutes to hours, and exposed equipment does not usually require decontamination.

Nonproliferation The use of the full range of political, economic, or informational or military tools to prevent proliferation of NBC weapons and missiles, reverse it diplomatically, or protect U.S. interests against an opponent armed with NBC weapons.

NPT Nuclear Non-Proliferation Treaty.

Nuclear, biological, and chemical (NBC) weapons Weapons that are characterized by their capability to produce mass casualties using NBC means and whose threat or use introduces individually diverse and distinct challenges to the planning and conduct of military operations. This does not include riot control agents or herbicides, but may include toxic industrial chemicals (specifically toxic inhalation hazards) and radiological materials that are weaponized for employment against personnel.

Occupational and environmental health threats Threats to the health of personnel and to military readiness created from exposure to operational military activities, hazardous agents, environmental contamination, or toxic industrial materials. In this context, these occupational and environmental factors combine to produce disease, nonbattle injuries, combat operational stress reactions, and other threat hazards.

OPCW Organization for the Prohibition of Chemical Weapons

Operational health threat Threats to the health of military personnel and to military readiness created by an adversarial combat force using conventional or (in this context) unconventional weapon systems, such as CB warfare agents, radiological contamination, or nuclear weapons effects to produce immediate casualties.

Passive defense Defensive measures (rather than the offensive measures in counterforce and active defense) that enable friendly forces to survive, fight, and win military operations despite the enemy's employment of NBC weapons or agents.

Pathogen A disease-producing microorganism, either bacteria, viruses, rickettsia, or fungi. Pathogens are living organisms, unlike toxins that are chemicals derived from microorganisms.

PB Pyridostigmine bromide

PDD Presidential Decision Directive

Persistent agent A CW agent that, when released, does not immediately dissipate or evaporate, and that through its contact hazard can cause casualties for an extended duration (hours to days). Equipment contaminated with persistent agent requires operational and thorough decontamination prior to use by unprotected persons.

Precursor A chemical that can be combined with another substance or substances to form a CW agent. Many precursors have commercial uses as well as military uses, and the use of CW precursors are tracked by international efforts.

Presumptive identification A method of immediate identification intended to provide sufficient information on the nature of the BW attack to implement necessary personal, protective, and medical countermeasures. The purpose of presumptive identification is to get a quick, immediate indication of what the hazard is; this identification is not meant to substitute for a medical diagnosis.

Prophylaxis Medical measures taken to preserve an individual's health and prevent the spread of disease. Prophylactic measures can include those taken after exposure to CB agents but prior to the onset of symptoms, in contrast to medical treatment, which occurs after the onset of symptoms.

Protective ensembles Generally a camouflage-colored, expendable, two-piece overgarment consisting of a coat and trousers (aircrew ensembles are typically one-piece overgarments). These garments provide protection against chemical agent vapors, liquid droplets, biological agents, and radioactive alpha and beta contamination. Protective qualities last from thirty to forty-five days once the garment is removed from its bag, depending on the particular suit, and the garment provides twenty-four hours of protection against exposure to liquid or vapor chemical agents.

Protective mask A protective cover designed to protect the wearer's face and eyes and to prevent breathing air contaminated with chemical vapors, biological organisms, and radiological particles. They are often erroneously referred to as "gas masks," when they will also protect against the inhalation of biological and radiological hazards.

PSI Proliferation Security Initiative

Psychochemicals A subgroup of incapacitant chemical agents that alter the nervous system, causing visual and aural hallucinations, a sense of unreality, and changes in thought processes and behavior.

Quarantine The detention, isolation, or restriction of the activities of people or animals that have been exposed to a communicable disease to prevent the spread of the disease to others. The restriction is enforced during the incubation period (period of time in which the disease can be transmitted to another). Quarantine differs from isolation in that people who do not show signs or symptoms of any disease are being restricted in their movement.

Radioactive Dispersal Device (RDD) Any device that causes the purposeful dissemination of radioactive material across an area without a nuclear detonation. The mode of dispersal typically described as an RDD is an explosive device coupled with radioactive material. An RDD poses a threat to public health and safety and the environment through the spread of radioactive materials, and any explosive device presents an added immediate threat to human life and property. Other means of dispersal, both passive and active, may be employed. Such incidents may include covert pumping or spraying of a radioactive liquid, aerosol, or powder; spraying from aircraft; injection into air-handling systems or water supply lines; and other possible methods. Dissemination of radioactive material not carried out via a device would still be treated like an RDD by responders and decision makers.

Reconnaissance The process of obtaining information, through visual and other detection methods, about the activities and resources of an enemy, or (in the case of CBRN defense) securing data on the potential contamination or lack of contamination of a particular area or route. In this context, reconnaissance is usually an active measure to confirm or deny the suspected presence of a CB hazard in a particular area to ensure the safe movement of friendly forces.

Residual contamination Contamination that remains after deliberate steps have been taken to remove it. These steps may consist of nothing more than allowing the contamination to decay normally. Chronic exposure to residual contamination may be harmful, depending on the hazard and the duration of exposure.

Riot control agent (RCA) Any chemical compound that can rapidly produce sensory irritation or disabling physical effects that disappear within a short time following the termination of exposure; also known as tear gases.

Sampling The collection of a contained amount of CB materials sufficient for the purposes of presumptive, confirmatory, or unambiguous identification of a CB warfare agent.

SHAD Shipboard Hazard and Defense.

Simulant A chemical that has some physical or physiological feature(s) of a chemical or biological warfare agent. Simulants are used to allow test and evaluation agencies to assess the effectiveness of defense equipment without using actual toxic CB warfare agents.

Surveillance The systematic observation of a particular area, place, person, or thing by visual, aural, electronic, photographic, or other means. In this context, surveillance of a particular area is usually focused on identifying any change in the status of a CBRN hazard within a given area and over a period of time (for instance, ensuring that there is no agent hazard present at a particular location and that no new agents have arrived).

Survey The directed effort to determine the location and nature of the CBRN hazard in a defined area.

Terrorism The term *terrorism* means premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience. The term *international terrorism* means terrorism involving the territory or the citizens of more than one country. The term *terrorist group* means any group that practices, or has significant subgroups that practice, international terrorism.

Thickened agent An agent to which a polymer or plastic has been added to retard evaporation and to cause it to adhere to surfaces.

Threshold Dose The smallest amount of toxic substance that can produce the first recognizable injuries (for example, irritation of the skin, nausea, or miosis). The term may also refer to the level of a chemical that shall not be exceeded for even an instant (TLV-C, or threshold limit value ceiling). Some other common threshold doses are TLV-STEL (threshold limit value—short-term exposure), which is a level of exposure that cannot be exceeded for more than fifteen minutes, four times per day with an hour between exposures; TLV/TWA (threshold limit value/time weighted average), which is the amount of a product a person can be exposed to repeatedly during an eight-hour day/forty-hour week with no toxic effects; and TLV/Skin (threshold limit value/skin), which is the amount of material that causes skin irritation or that can be absorbed into the skin.

Toxic industrial chemical (TIC) A general term used to refer to any one of the 75,000 industrial chemicals, organic and inorganic, currently produced or imported into the United States which may pose an environmental or human-health hazard. Inhalation hazards may be the most dangerous, followed by corrosive, flammable, explosive, and chemically active chemicals. The level of danger involves both the amount of chemical present and the particular toxicity of the industrial chemical.

Toxic inhalation hazard A gas, vapor, or aerosol that can cause damage to a person as the result of asphyxiation, topical damage to the respiratory system, systemic damage to the organs, or allergic response.

Toxins Poisonous substances produced by living organisms. Examples include ricin, derived from castor beans, and botulinum toxin.

UAV Unmanned Aerial Vehicle

Unambiguous (or definitive) identification This process of identifying a BW sample is expected to occur at a national or designated laboratory and is sometimes referred to as the "gold standard." The purpose of this process is to provide unimpeachable information to national leaders as to the identity and source of a BW agent.

UNMOVIC United Nations Monitoring, Verification, and Inspection Commission

UNSCOM United Nations Special Commission

Vaccine A substance administered to induce immunity in the recipient. Vaccines can be further subdivided into FDA-licensed vaccines and Investigational New Drug (IND) vaccines. The latter require the subject to volunteer to take the vaccine with a full understanding of the potential side effects.

Vapor The gaseous state of a substance that at normal temperature would be a solid or a liquid. Generally, vapors condense back into a liquid state and thus may have both an inhalation and percutaneous effect.

Virus Any of the various submicroscopic pathogens consisting of a core of a single nucleic acid surrounded by a protein coat, characterized by a total dependence on living cells for reproduction and a lack of independent metabolism.

VLSTRACK Vapor, Liquid, and Solid Tracking Model

Vomiting agent A chemical compound that produces a strong pepper-like irritation in the upper respiratory tract, with irritation of the eyes and tearing; causes violent, uncontrollable sneezing, cough, nausea, vomiting, and general discomfort for minutes to hours after exposure.

Weapons of mass destruction (WMD) Weapons that are capable of a high order of destruction and/or being used in such a manner as to destroy large numbers of people. Such weapons include chemical, biological, radiological, and nuclear weapons or high explosives. This arms control term generally refers to the NBC weapons threat posed by adversarial nations or to their offensive programs developed to asymmetrically counter U.S. or coalition ally strengths.

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